

PRACTICAL SURGERY.

A TREATISE

DISLOCATIONS AND FRACTURES OF THE JOINTS;

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(ABRIDGED.)

WITH IMPORTANT ADDITIONS FROM THE WORKS OF THE
MOST DISTINGUISHED MODERN SURGEONS,
AND ILLUSTRATED BY NUMEROUS LITHOGRAPHIC ENGRAVINGS.

EDITED BY

ALEXANDER COOPER LEE.



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TO

SIR ROBERT PEEL, BARONET,

MEMBER OF PARLIAMENT FOR TAMWORTH;

ONE OF THE

BRIGHTEST ORNAMENTS OF THE BRITISH SENATE;

THE

DISTINGUISHED LEADER OF THE CONSERVATIVE PARTY

IN THE

HOUSE OF COMMONS;

WHOSE ORATIONS ARE FORMED

ON THE

STRICTEST MODELS OF CLASSIC ELOQUENCE;

WHOSE ENLIGHTENED VIEWS HAVE INTRODUCED

IMPORTANT AMENDMENTS INTO OUR CRIMINAL CODE,

WHOSE SKILL IN DEBATE, WISDOM IN COUNCIL,

AND AFFABILITY OF DEPORTMENT,

HAVE SECURED FOR HIM

THE CONFIDENCE OF ONE PARTY, AND THE ADMIRATION OF ALL;

THE PUBLISHER,—

AS A TRIBUTE OF ADMIRATION TO

EMINENT TALENTS, AND GREAT POLITICAL SAGACITY,

IN UNION WITH

LIBERALITY OF SENTIMENT, AND POLISHED COURTESY OF MANNER,—

DEDICATES THIS VOLUME.

P R E F A C E.

IN preparing the Work which is now offered to the Profession for their approval, the object of the Editor was to present in a concise, clear, and convenient form, the nature, diagnosis and treatment of a large and important class of injuries.

In pursuance of this object he has divided the Work into three Parts :—the first of which contains a description of the nature and treatment of all the dislocations of the body, generally and specially ;—the second is, in like manner, devoted exclusively to fractures ;—and the third contains a description of the nature and treatment of injuries of the head and spine, a class of injuries that differ materially from the two preceding in the character of the symptoms which attend them. By the adoption of a classification such as this, the Editor conceived that the peculiar features of each class of accidents could be studied with greater advantage.

The first Part, which treats of the various dislocations of the body, is founded almost exclusively on the Lectures and Surgical Essays of Sir A. Cooper. The second Part, which is confined to the nature and

treatment of fractures, has been founded, partly on the Works of Mr. S. Cooper and other eminent modern surgeons who have written on the subject; and partly on the before mentioned Lectures and Essays of Sir A. Cooper. In this part of the Work, Sir A. Cooper's remarks are confined to the treatment of compound fractures, fractures of the cervix humeri, cervix femoris, patella, and indeed all those fractures which occur in the immediate neighbourhood of joints, and are therefore liable to be mistaken for dislocations. While the greater portion of this section of the Work is occupied by a description of the nature, diagnosis, and treatment of fractures generally, and of those fractures in particular to which the shafts of bones are liable; constituting by far the most common class of accidents, and which have not been mentioned in any of Sir. A. Cooper's Works. The materials of the third Part are solely derived from the Lectures of Sir A. Cooper.

Those portions of the Work which are founded upon Sir A. Cooper's published Essays and Lectures, have been verified by a careful collation of the various editions with each other, and with his Treatise on Fractures and Dislocations of the Joints; the matter has been abridged in bulk; all cases, which seemed superfluous or redundant, have been omitted; and the language has been carefully revised: the object of the Editor being rather to present the opinions of the Author in a clear and concise form, than to preserve

a certain set form of words, merely because they purported to be those which had been made use of by Sir A. Cooper. In those portions of the Work which are derived from other sources, the Editor has adopted a similar freedom; collecting his materials from the best available sources; arranging them in the manner which appeared, to him, most readily to convey a correct idea of the subject, and endeavouring to present them before the reader in as plain and intelligible form as possible.

Such is a brief sketch of the nature of the Work which is now submitted for public approbation. Considering the source from whence the major part of its materials were derived, but little apology would under any circumstances have been necessary for its appearance; far less is it needed at a time when we are all inclined to cherish more dearly the precepts of a man, who has just passed from the scene where he had laboured so long, with credit to himself and benefit to his fellow creatures.

At a moment like the present, while we are still mourning over his departure, the best and noblest tribute that can be offered to the memory of this great man may be traced in the feeling of reverence, almost of adoration, which is entertained for his moral qualities as a man, his eminently practical observations as a surgeon, and, above all, the untiring industry and devotion, which he evinced in the exercise of his profession during the period of more than half a century.—

Well, indeed, may he be regarded as a model, worthy of imitation. For while others, by their genius, have gained a deservedly high position in the ranks of our profession ;—he, by industry alone, has earned for himself a reputation that will endure as long as British surgery is known.

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DISLOCATIONS.



DISLOCATIONS.

INTRODUCTION

DISLOCATIONS IN GENERAL.

Definition A DISLOCATION is a displacement of the articulatory portion of a bone from the surface on which it was naturally received.

Necessity of prompt assistance. Of the various accidents which happen to the body, there are few which require more prompt assistance, or endanger the reputation of the surgeon more than cases of luxation ; as the restoration of the injured parts depends very much upon his assistance. For if much time shall have elapsed before the attempt at reduction be made, the difficulty of accomplishing it will be proportionably increased, and often totally impracticable. If the nature of the injury be unknown, and the luxation consequently remain unreduced, the patient becomes a living memorial of the surgeon's ignorance or inattention.

Consequences of neglect. I have known several instances in which the want of professional knowledge or inattention

to these accidents on the part of the surgeon, has been the occasion of irrecoverable injury to his patient, and of the loss of his own professional character.

Knowledge of anatomy necessary A considerable share of anatomical knowledge is required to detect the nature of these accidents, as well as to suggest the best means of reduction; and it is much to be lamented that students neglect to inform themselves sufficiently of the structure of the joints. They often dissect the muscles of a limb with great neatness and minuteness, and then throw it aside, without any examination of the ligaments, cartilages, or ends of the bones; a knowledge of which, in a surgical point of view, is of infinitely greater importance. Hence arises the errors into which they fall when they embark in the practice of their profession; for the dislocations of the hip, the elbow, and the shoulder, are scarcely to be detected, but by those who possess accurate anatomical information.

Even our hospital surgeons, who have neglected their anatomy, mistake these accidents; and I have known the pulleys applied to an hospital patient, in a case of fracture of the neck of the thigh-bone, which had been mistaken for a dislocation, and the patient exposed, through the ignorance of the surgeon, to a violent and protracted extension.

It is therefore proper that the form of the extremities of the bones, their mode of articulation, the ligaments by which they are connected, and the direc-

tion in which their most powerful muscles act, should be well understood.

Difficulty from tumefaction. In some cases, however, so much tumefaction arises from extravasation of blood, or the parts become so tense from the inflammation which frequently ensues, that, in the early days of the accident, the best surgeon will find it difficult to ascertain exactly the extent of the injury; and, therefore, it would be both illiberal and unjust to attribute ignorance to a surgeon who might have given an incorrect opinion under such circumstances.

Some joints more easily dislocated than others. Some joints dislocate much more frequently and easily than others. Those which have naturally extensive motions are easily dislocated, and hence dislocation at the shoulder joint occurs much more frequently than at any other; and, having once occurred, it happens again easily in the mere natural elevation of the arm. It is wisely ordained, that when a part has extensive motion, and great strength is required, there is always a multiplicity of joints. Thus, in the spine, where great strength is necessary to protect the spinal marrow, numerous joints are formed; and the motion between any two bones is so small, that dislocations rarely occur, except between the first and second vertebrae, although the bones are often displaced by fracture. The carpus and the tarsus are constituted in a similar manner; they allow of considerable motion, yet maintain great strength of union. For if the motion

between two bones, as in the spine, be multiplied by twenty-four, and that at the carpus by eight, the result will shew that great latitude of motion is given, and the strength of the part preserved ; whilst, if the spine had been formed of a single joint, dislocations might have easily happened, and death, from this cause, would have been a frequent consequence.

SECTION I.

EFFECTS OF DISLOCATION.

a. Immediate effects.

^{Immediate ef-}
^{fects.} The immediate effects of dislocation are,—to change the form of the joint, frequently to produce an alteration in the length of the limb, almost entirely to destroy the motions of the joint after the muscles have had time to contract, and to alter the axis of the limb.

^{Considerable}
^{motion at first.} In the first moments, however, of the dislocation, considerable motion remains. I have seen a man brought into Guy's Hospital, who, but a few minutes before, had the thigh-bone dislocated into the foramen ovale ; and I was surprised to find, in a case otherwise so well marked, that great mobility of the bone still existed at the dislocated part, but in less than three hours it became firmly fixed in its new situation by the permanent, or, as it is called, tonic contraction of the muscles.

Length of limb altered.

In some dislocations the limb is rendered shorter, thus throwing the muscles of the limbs into a state of relaxation. But when the femur is displaced into the foramen ovale, or the humerus into the axilla, the limb is elongated, producing extreme tension of the principal muscles around the joint, which are sometimes stretched even to laceration.

Effusion of blood.

Blood is often effused in considerable quantity around the joint, which renders detection of the accident difficult; the swelling being sometimes so considerable as to conceal entirely the ends of the bones.

Effect of pressure from the dislocated bone.

A severe but obtuse pain arises from the pressure of the head of the bone upon the muscles, and sometimes this pain is rendered more acute from its pressure upon a large nerve; as when the femur is dislocated into the ischiatic notch, or the humerus into the axilla. From this cause, also, paralysis of the parts below is produced, instances of which occur in dislocations of the shoulder. At other times, the bone presses upon important parts, so as to produce effects dangerous to life. I have, for many years, mentioned a case of dislocated clavicle, which pressed upon the oesophagus so as to endanger life: the particulars of this case were furnished me by Mr. Davie, of Bungay, and which I shall take notice of hereafter.

Vessels injured.

The large blood vessels also, occasionally, receive much injury from these accidents. I

have known the subclavian artery to be so much compressed by a dislocation of the sternal extremity of the clavicle backwards, as to stop completely the pulsation at the wrist. In another case, the axillary artery was so much injured by a dislocation of the humerus into the axilla, as to give rise to aneurism; for the cure of which the subclavian artery was tied.

^{Head of bone felt.} If there be not much extravasation or effusion, the head of the displaced bone may be easily discovered in its new situation, and may be distinctly felt to roll, if the limb be rotated. In some instances, the usual prominence of the joint is lost, as when the humerus is dislocated into the axilla. In others an unnatural projection occurs, as in dislocations of the elbow.

b. Remote effects.

^{Crepitus.} A sensation of crepitus is frequently produced by the effusion of adhesive matter (*fibrin*) into the joint and bursæ; the synovia becomes inspissated, and crackles under motion, a circumstance of which every practitioner should be aware, as he might otherwise be induced, erroneously, to suspect the existence of fracture where none had occurred.

^{Inflammation and suppuration.} The degree of inflammation which succeeds to these accidents is generally slight. Sometimes it becomes so considerable as to produce a tumefaction, which, added to that resulting from extravasation of blood, frequently renders the detection

of the injury very difficult. Sometimes, after the reduction of the dislocation, suppuration ensues, and the patient falls a victim to excessive discharge and irritation.

Case Mr. Howden, who was one of our most intelligent apprentices at Guy's Hospital, and was afterwards surgeon in the army, related the following case :—"A man had his thigh dislocated upwards and backwards on the ilium, which was soon afterwards reduced ; the next day a considerable swelling was observed on the part, which continued to increase, accompanied with rigours, and in four days the patient died. On dissection, the capsular ligaments, and ligamentum teres were found entirely torn away, and a considerable quantity of pus extravasated in the surrounding parts."*

Case I attended the master of a ship, who had dislocated his thigh upwards ; an extension was made, apparently with success ; but in a few days a large abscess formed on the thigh, which destroyed the patient.

SECTION II.

APPEARANCES ON DISSECTION.

On examination of the bodies of persons who die in consequence of dislocations arising from violence,

* Minutes of the Physical Society, Guy's Hospital, Nov. 12th, 1791.

the head of the bone is found completely removed from its socket.

Ligaments. The capsular ligament is torn transversely to a great extent; the peculiar ligaments of each joint, as the ligamentum teres of the hip, are torn through; but the tendon of the biceps, in dislocations of the os humeri, remains uninjured, as far as I have been able to ascertain by dissection; although I do not mean to assert, that this is universally the case.

Tendons. The tendons which cover the ligaments are also torn; as the tendon of the subscapularis muscle in dislocation into the axilla: and, according to the extent of this laceration, will be the facility with which the accident may recur after reduction; a circumstance frequently very difficult to obviate.

Muscles. Some of the muscles are much injured, being in some cases put upon the stretch, even to laceration; as the pectineus and adductor brevis, in dislocation of the thigh downward; and large quantities of blood become extravasated into the cellular tissue. In other cases they are shortened.

*When unreduced
for a long time.* When a dislocation has remained unreduced for a length of time, some degree of motion is gradually restored, but the power and mobility of the limb are never completely regained; and, in dislocations of the thigh, the patient is ever after lame.

*Dissection of
old dislocations.* In dissecting cases of this kind, the head of the bone is found much altered in figure; not so

much depending upon the length of time that the bone has been displaced, as whether the structure, upon which the head of the bone presses, be bone or muscle.

^{If resting on}
_{muscle.} If it rest upon muscle, the bone undergoes but little change; its articular cartilage remains, and a new capsular ligament forms around it, from the thickening and condensation of the surrounding cellular tissue.

^{If on bone.} If, on the contrary, it presses upon bone, an extraordinary change is produced, both in the head of the dislocated bone, and in the osseous surface on which it rests. The articular cartilage from the dislocated bone becomes absorbed, and the periosteum of the bone on which it presses is removed in the same manner, so that a smooth hollow surface is formed, to which the head of the displaced bone becomes adapted. At the same time that this hollow is being formed in the osseous surface on which the head of the dislocated bone immediately presses, a deposit also takes place from the surrounding periosteum, between it and the surface it naturally covers, by which a ridge or lip is produced, forming, with the depression, a deep cup to receive the head of the bone. The new cup which is thus formed, sometimes so completely surrounds the neck of the bone, as to prevent its being removed from it without fracture; and the socket upon its internal surface is so smooth as to leave no projecting parts which can interrupt the motion of the bone in its new situation.

Also, the tendons or muscles which were lacerated, are united, and the latter accommodate themselves to their altered positions, so that, by a beautiful and gradual change in the injured parts, a new articulation is established.

SECTION III.

CAUSES.

Violence. Violence is usually the cause of dislocations, and is generally applied unexpectedly, when the muscles are not prepared for resistance, and when the bone is in an oblique position with respect to its socket. Under such circumstances, very slight force will produce a displacement which could not otherwise be occasioned, but by great violence.

Execution of Damien. The power of the muscles in resisting excessive force, when prepared for its application, is well illustrated by what occurred in the execution of Damien, for an attempt to murder Louis the XVth. Four young horses were fixed, one to each limb, and then compelled to draw in different directions, for the purpose of tearing the limbs from his body. This, however, could not be effected, and, after fifty minutes' trial, the executioners were obliged to cut through the muscles and ligaments, before the limbs could be separated.

Dislocation rare in old persons. Old persons are much less liable to dislocations than those of a middle age, as from

the difference in the firmness of their bones, those of the former are much more easily broken than displaced.

In very young In very young persons, also, dislocations are rare, as the bones break, or the epiphyses give way under the violence which would otherwise displace them. I have, however, known an instance of dislocation in a child of seven years of age. Displacement often occurs in children from ulceration, and is most frequent at the hip joint.

Dislocations from relaxation of the ligaments But although dislocations generally happen from violence, and are accompanied by laceration of the ligaments of the joint, yet they may occur from relaxation of the ligaments only.

Case. A girl came to my house, who had the power of throwing her patellæ from the surfaces of the condyles of the os femoris. Her knees were bent considerably inwards; and when the rectus muscle acted upon the patella, it was drawn from the thigh bones into a line with the tubercle of the tibia, and laid nearly flat upon the side of the external condyle of the femur. She came from the south of Europe, and said she had been brought up as a dancing girl from her earliest years, thus gaining her daily bread, as we see children dancing upon platforms in the streets of London; and she imputed her weakness to these early and continued exertions.

Dislocation from accumulation of synovia. A similar relaxation of ligaments is also produced by an accumulation of synovia in the joints, of which I have seen several cases.

case The following is an illustration :—Ann Parish was admitted into Guy's Hospital in the autumn of 1810, for a dislocation of the left patella, from relaxation of the ligaments. She had for four years previously a large accumulation of synovia in that knee, causing some pain, and much inconvenience in walking. Blisters had been applied without much effect, and other means tried for four months before her admission. When the knee had acquired considerable size, the swelling spontaneously subsided, and she then first discovered that the patella became dislocated when she extended the limb. She suffered some pain whenever this happened, and she lost the power of extending the limb in walking, so that she fell when the patella slipped from its place, which it did whenever she attempted to walk without a bandage. The patella was placed upon the external condyle of the os femoris, when thrown from its natural situation, to which it did not return without considerable pressure of the hand. In other respects her health was good. Straps of adhesive plaster were ordered to be applied, and a roller to be worn, which succeeded in preventing the dislocation so long as they were used, but the bone again slipped from its place whenever they were removed. A knee cap, made to lace over the joint, was ordered for her.

Loss of muscular power Dislocation sometimes arises from a loss of muscular power ; when the muscles lose their tone through long and forcible extension, or paralysis, a bone may easily be dislocated, but, under such cir-

cumstances, as readily replaced. Of the first of these two causes, the following case is an illustration.

Case of dislocation from atomity A junior officer on board of one of the Company's ships in India, was punished by one of the mates, for some trifling offence, in the following manner :—His foot was placed upon a small projection on the deck, and his arm was lashed tightly to the yard of the ship. In this position he was kept for an hour. When he returned to England, he had the power of readily throwing that arm from its socket, merely by raising it towards his head, but a very slight extension reduced it; the muscles were also wasted, as in a case of paralysis.

Case of dislocation from paraly sis The following is an example of the influence of paralysis :—A young gentleman had one of those paralytic affections in his right side, which frequently arise during dentition. The muscles of the shoulder were wasted; and he had the power of throwing his os humeri over the posterior edge of the glenoid cavity of the scapula, from whence it became easily reduced.

These cases, particularly the latter, prove that no laceration of the ligaments could have occurred; and they shew the influence of the muscles in preventing dislocation from violence, and in impeding its reduction.

Dislocation from ulceration Dislocations frequently occur from ulceration, by which the ligaments are detached, and the bones become destroyed. Displacement, in these cases, occurs, either from the action of the muscles,

or from there not being support to counteract the weight of the bone. We frequently find this state of parts in the hip-joint: the ligaments ulcerated, the edge of the acetabulum absorbed, the head of the thigh-bone changed both in its magnitude and figure, escaping from the acetabulum upon the ilium, and there forming for itself a new socket. There is in the anatomical collection at St. Thomas's Hospital, a preparation of the knee dislocated by ulceration, and ankylosed at right angles with the femur; the tibia being turned directly forwards.

SECTION IV.

PARTIAL DISLOCATIONS.

Dislocations are not always complete; but, in some instances, partial displacement of bones from their articulatory surfaces, occurs; this species of dislocation now and then takes place at the ankle-joint.

Instances:—the ankle. An ankle was dissected by Mr. Tyrrell, and given to the collection of St. Thomas's, which was partially dislocated. The end of the tibia still rested in part upon the astragalus, but a larger portion of its surface was situated on the os naviculare; and the tibia, altered by this change of position, had formed two new articulatory surfaces, with their faces turned in opposite directions. The dislocation had not been reduced.

The knee. The knee-joint is seldom completely dislocated; for the extent of its articular surfaces almost precludes the possibility of complete displacement.

The upper extremity. The humerus is sometimes thrown upon the anterior edge of the glenoid cavity, but it readily returns into its socket; and the elbow-joint is liable to partial dislocation, both of the ulna and the radius.

The lower jaw. The lower jaw is sometimes partially dislocated, but in a different manner; one of the joints being luxated, while the other remains entire.

SECTION V.

DISLOCATION WITH FRACTURE.

It frequently happens that fracture occurs at the same time with dislocation. This is more especially the case in dislocations of the ankle, which seldom occur without fracture. Dislocations of the humerus are sometimes accompanied with fracture of the head of the bone. The coronoid process of the ulna is occasionally separated when that bone is dislocated, which renders it scarcely possible to preserve the parts in their natural position. The acetabulum is sometimes broken in dislocations of the hip; and in one case, admitted into Guy's Hospital, the detached portion of acetabulum perforated the jejunum, and produced death.

Management of
such cases.

When dislocation and fracture of the same bone occur, the dislocation should, if possible, be reduced without loss of time, taking care to prevent any further injury to the muscles, by the application of bandages and splints; for, if the fractured bone be allowed to unite before attempting to replace the dislocation, such union would most probably be destroyed by the additional violence necessary to reduce the bone, after remaining so long out of its natural situation.

So also if there be dislocation in one limb, and fracture in another, of the same person, the dislocation should be reduced as soon as the fractured bone has been supported and secured from injury.

Accidents, which have been called dislocations of the spine, are really fractures of the vertebræ, followed by displacement of the bones, and not true dislocations; excepting those of the upper cervical vertebræ, dislocations of which are said to have occasionally occurred.

SECTION VI.

COMPOUND DISLOCATIONS.

Dislocations are either simple or compound; the *simple dislocation* is rarely dangerous, and those are considered as simple in which the skin remains unbroken, although the accident may be otherwise complicated.

In a *compound dislocation*, besides the displacement of the articulating surfaces, the cavity of the joint is laid open by a division of the skin, capsular ligament, and intermediate soft parts, producing extravasation of blood into the joint, and allowing the escape of the synovia.

But dislocations, unattended by wounds, may sometimes become compound, unless great care be taken to prevent the pressure of the end of the bone, which might otherwise occasion inflammation and ulceration.

Danger of. This injury is usually attended with considerable danger, on account of inflammation occurring in the synovial membrane, and lacerated ligaments. The former quickly takes on the suppurative inflammation, and thus a profuse discharge rapidly ensues. The articular cartilages covering the extremities of the bones are gradually destroyed by an ulcerative process ; the bone inflames, and granulations are thrown out from its extremity, now denuded of cartilage, to fill up the cavity. Generally, these granulations unite, and become ossified, producing ankylosis; but occasionally some degree of motion is gradually regained.

Often require amputation. To effect all this, great constitutional powers are necessary, and persons naturally weak are often, under these circumstances, obliged to submit to the removal of the limb to preserve their life.

Rare in some joints. Compound dislocations occur but very

rarely in some joints, as the hip, shoulder, and knee ; but are often met with in the ankle, elbow, and wrist.

^{Judicious treatment.} Much may be done, in these cases, by judicious treatment in the first instance ; when the object should be to promote adhesions of the external wound, and so render the dislocation simple. Instead of applying emollients, therefore, to encourage suppuration, a practice that is productive of much mischief, the edges of the wound should be carefully approximated by strips of plaster, and evaporating lotions applied over the limb, which ought to be left undisturbed for several days.

I shall, however, enter more fully into the treatment of these injuries, when describing the particular dislocations.

SECTION VII.

TREATMENT.

a. Difficulties opposing reduction.

^{Form of the joint.} In the reduction of recent dislocations, (often a difficult task,) the form of the joint may, in some instances, occasion impediments. In some cases, the articular cavity is surrounded by a projecting edge, as in the hip-joint ; and the head of the bone, during the act of reduction, stopping at this projection, requires to be lifted over it. Another difficulty occurs, if the head of the bone be much larger than its cervix, as in dislocation of the

head of the radius. But still these are slight difficulties in comparison with others which we have to encounter.

The capsular ligaments. The capsular ligaments are supposed to resist reduction. But those, who entertain that opinion, must forget their inelastic structure, and cannot have had opportunities of witnessing, by dissection, the extensive laceration which they sustain in dislocations by violence. The idea of the neck of the bone being girt or confined by the ligament is quite untrue. The capsular ligaments possess, in truth, but little power, either to prevent dislocation, or to resist the means of reduction; for, if the tendons with which they are covered, and the peculiar ligaments of the joints did not exist, dislocation must necessarily be of very frequent occurrence.

Tendons. The joint of the shoulder, and those of the knee and elbow, are strongly protected by tendons; the shoulder by those of the spinati, sub-scapularis, and teres minor muscles; the elbow by the triceps and brachialis; the knee by the tendinous expansion of the vasti.

Peculiar ligaments. But still some ligaments resist dislocations; these, however, are the peculiar, not the capsular ligaments. The wrist and the elbow have their appropriate lateral ligaments to give additional strength to these joints. The ligamentum teres of the hip-joint prevents a ready dislocation downwards. The knee has its lateral and crucial ligaments. And

the ankle, exposed as it is to the most severe injuries, is provided with its deltoid and fibular tarsal ligaments, of very extraordinary strength, to prevent dislocation ; indeed, the bones of this joint often break, rather than their ligaments give way. However, in many of the joints, these ligaments, being torn, afford no assistance to the reduction of dislocations, as in the hip, elbow, and wrist ; but one of them remaining entire, will become an obstacle to the reduction, as I have seen in the knee-joint.

Resistance of muscles. The difficulty in reducing dislocations arises principally from the resistance which the muscles present by their contraction, and which is proportioned to the length of time that has elapsed after the injury ; it is, therefore, desirable not to delay the attempt at reduction too long.

*Fatigue of mus.
cles.* A muscle, when excited to action by volition, soon becomes fatigued, and requires rest. The arm can be extended only for a few minutes, at right angles with the body, before it feels a fatigue which requires a suspension of action ; and, indeed, the same law governs involuntary action,—the heart has its contraction and relaxation.

*Permanent con-
traction.* But, in addition to these common actions, which are either voluntary or involuntary in their nature, and require intermission, the muscles have a power of contraction, independent of either state, and permanent in its character. So that when a muscle is divided, its parts contract ; or

when the antagonist muscle is cut, the undivided muscle draws the parts into which it is inserted into a fixed situation. Thus, if the biceps muscle be divided, the triceps keeps the arm constantly extended; if the muscles on one side of the face are paralytic, the opposing muscles draw the face to their side. This contraction is not succeeded by fatigue or relaxation, but will continue an indefinite time, even until the structure of the muscle becomes changed; and its contraction increases from the first occurrence of the accident. Thus, when a bone is dislocated, the muscles draw it as far from the joint as the surrounding parts will allow, and fix it there by their contraction. It is this resistance from muscles, aided by their voluntary contraction, which the surgeon is required to counteract. If an extension be made almost immediately after a dislocation has happened, the resistance produced by the muscles is easily overcome: but if the operation be postponed for a few days only, the utmost difficulty occurs in effecting it.

That the muscles are the chief cause of resistance, is strongly indicated by those cases in which the dislocation is accompanied by injury to any vital organ, and when the power of muscular action is diminished; for a very slight force will then be found sufficient to return the bone to its situation. Thus, in the case already mentioned*, of the man who had a laceration

* See page 17.

of the jejunum, through dislocation of the hip, the bone was restored to its place with little difficulty.

^{Other difficult-}ies. But independent of muscular contraction, other circumstances give rise to difficulty in attempting to reduce a dislocation that has long existed, and often render reduction impossible. The head of the bone contracts adhesion to the surrounding parts, so that even when the muscles are removed by dissection, the bone cannot be reduced. In this state I found the head of a radius, which had long been dislocated upon the external condyle of the os humeri, and is preserved in the collection at St. Thomas's Hospital. I have also found the head of the humerus, when dislocated, in a similar state. Sometimes, the socket is filled with adhesive matter, so that even if the bone were reduced, it could not remain in its original situation, the original cavity being in part filled with ossific matter, so as to render it incapable of receiving the head of the bone. Lastly: a new bony socket is occasionally formed, which so completely confines the head of the bone, that fracture only will allow it to escape from its new situation.

b. Constitutional means of reduction.

^{Means of reduc-}tion. The means to be employed for the reduction of dislocations, are both constitutional and mechanical. It is generally wrong to employ force only, since it would be required in so great a degree

as to occasion violence and injury; and, in the sequel, it will be shown that the most powerful mechanical means fail when unaided by constitutional remedies.

^{Constitutional} means. It is necessary, therefore, in the first instance, to diminish the power of the muscles by the employment of those constitutional means which produce a tendency to syncope. This necessary state may be best induced by one or other of the following means, viz.: bleeding, warm bath, and nausea.

Bleeding. Of these three remedies, bleeding is, by far, the most powerful. It is also the most speedy method, if the blood be drawn from a large orifice, and the patient kept in the erect position; a mode of depletion by which syncope is produced before too large a quantity of blood is lost. This practice cannot, however, be resorted to in all cases, but must be regulated by the constitution of the patient; in the young and robust, it may be employed with safety and advantage, but it would be highly injurious in very old or debilitated persons.

Warm bath. In some cases the warm bath may be deemed necessary, either as a substitute for, or an adjunct to, bleeding. In using it the temperature should be from 100° to 110°; and, as the object to be accomplished is the same as in bleeding, the person should be kept in the bath at the same heat till the faintness is produced; he should then be immediately placed in a chair, wrapped in a blanket, and the mechanical means employed as quickly as possible. The

desired effect, however, is much sooner produced by abstraction of blood, during the time that the patient is in the bath, than by bleeding, or the bath singly.

Nausea. A third mode of lowering the action of the muscles, which I have practised of late years, consists in the exhibition of nauseating doses of tartarized antimony. Its action, however, is uncertain, frequently producing vomiting, which is unnecessary; I therefore recommend its application merely for the purpose of keeping up that state of syncope already produced by the two preceding means, which its nauseating effects will most readily do: so that dislocations may be reduced with much less effort, and at a much more distant period from the accident, than can be effected in any other way. Indeed, by the combination of bleeding, the warm bath, and nauseating doses of tartarized antimony, two dislocations were reduced at a more distant period from the accident than I have ever known in any other example.

Opium. The effect of opium I have never tried, but it would probably be useful in a large dose, from its power of diminishing muscular and nervous influence.

c. Mechanical means of reduction.

Extension. After lessening the powers of the muscles, the reduction of the bone is to be attempted, by

fixing one bone, and drawing the other towards its socket.

Inattention to this point is one of the greatest causes of failure in attempting to reduce dislocations; for if the bone, in which the socket is placed, be not fixed, the reduction cannot be accomplished. If, for example, in attempting to reduce a dislocation of the shoulder, the scapula be not fixed by an assistant, it will necessarily be drawn with the humerus, and the extension will consequently be very imperfectly made. The one bone, therefore, must be firmly fixed, or drawn in the opposite direction, whilst the other is extended.

Extension should be gradual. The extending force should be only gradually applied, and continued rather to fatigue than extend the muscles by violence. For violence is as likely to tear sound parts, as to reduce the dislocation luxated; and it is apt to excite all the powers of resistance in opposition to the efforts of the surgeon.

Compound pulley. The force required may be applied either by the exertion of assistants, or by a compound pulley. But as the object of the surgeon is to extend the muscles by gradual, regular, and continued efforts; the pulley, in cases of difficulty, should always be resorted to, because its operation is gentle, continued, and under the direction of the surgeon's mind. Whereas the extension made by assistants is sudden, violent, and often ill directed, and is more likely to

produce laceration of the soft parts, than to restore the bone to its situation. Their efforts, also, are frequently uncombined, and their muscles as necessarily fatigue, as those of the patient, whose resistance they are employed to overcome.

Mode of applying the pulleys. Before applying the pulleys, a wetted roller should be put round the limb, and the leather to which the rings are fixed to receive the hook of the pulleys, should be buckled on over this roller; which will prevent it from slipping during the extension. The cord should at first be drawn very gently, until the resistance of the muscles is felt, when the surgeon should rest for two or three minutes, and then gradually and carefully extend again, and so on until he perceives the muscles quiver; after which a very little more extension will accomplish the desired purpose.

Pulleys should always be employed in dislocations of the hip-joint; and, also, in those dislocations of the shoulder which have long remained unreduced. Not that I mean to doubt the possibility of reducing such dislocations by the aid of men only, but to point out the inferiority of this mode in comparison with the employment of pulleys. Most writers on surgery, since the time of Ambrose Paré, have mentioned their use, but they have not duly appreciated them. Mr. Cline, whose professional judgment every one must acknowledge, always strongly recommended them.

Relaxation of the stronger muscles. During the employment of mechanical means in attempting the reduction of luxations, the surgeon should endeavour to obtain a relaxation of the stronger opposing muscles. The limb should therefore, as far as possible, be kept in a position between flexion and extension. How often has it happened that, in compound fracture, the bone, which could not be brought into apposition under the most violent efforts while the limb was in the extended position, was quickly replaced by an intelligent surgeon, who simply directed the limb to be bent, and the muscles to be placed in a comparative state of relaxation ?

Should extension be applied to the dislocated bone? A difference of opinion exists, whether it is better to apply the extension on the dislocated bone, or on the limb below. M. Boyer, who has long taken the lead in Parisian surgery, prefers the latter mode. As far as I have had an opportunity of observing, it is generally best to apply the extension to the dislocated bone. There are, however, exceptions to this rule in recent dislocations of the shoulder, which I generally reduce by placing the heel in the axilla, and drawing the arm at the wrist in a line with the side of the body.

Influence of the mind. Much advantage may be gained in these cases, while the surgeon is attempting the reduction, by drawing the patient's attention from the accident; for the muscles, acting in obedience to the will, afford much resistance, as long as the mind is

directed to them. But this resistance subsides as soon as any other circumstance engages the patient's attention. I have, in this way, reduced a dislocation of the humerus, by simply directing a patient to rise, at the time I was making extension by the wrist with my heel in the axilla, after having made various unsuccessful efforts, whilst he was recumbent. In attempting to rise, the mind was directed to other muscles than those opposing the reduction; and thus the force they had previously exercised, was so far diminished as to allow of the reduction.

Signs of its being reduced. The surgeon may know that a dislocation is reduced by the restoration of the natural form of the joint, the recovery of its original motion, and a slight snap, which is generally heard when the bone returns into its articular cavity.

Time for attempting reduction. In dislocations of the shoulder, a period of three months after the accident, and in those of the hip, eight weeks may be fixed as the period, beyond which it would be imprudent to attempt reduction; except in persons of extremely relaxed fibre, or of advanced age. At the same time, I am fully aware, that the shoulder has been reduced at a more distant period than that just mentioned, but, in most instances, with severe injury to the soft parts.

After-treatment. For a few days after reduction by the pulleys, the bone will not remain in its articular cavity without the aid of bandages to support it till muscular action returns

The hip is rarely dislocated a second time; but the shoulder and the lower jaw very frequently slip again from their sockets, owing to the shallowness of the cavity into which the head of the bone is received; and, therefore, they require bandages for a considerable period subsequent to reduction.

^{Rest of the} ~~Old~~ limb. Rest is necessary for some time after the reduction of the dislocation, in order to produce a union of the ruptured ligament, which would otherwise be prevented by exercise. Evaporating lotions should be employed, to prevent excess of inflammatory action; and even leeches ought to be applied if the inflammation be very severe. The strength of the muscles and ligaments is then to be restored by pouring cold water upon the limb, and by the subsequent employment of friction.

d. Unreduced dislocations.

<sup>Old dislocations
not to be reduced.</sup> I believe that much mischief is produced by attempts to reduce dislocations of long standing in very muscular persons. I have seen great contusion of the integuments, laceration and bruises of muscles, tension of nerves, leading to an insensibility and paralysis of the hand, occasioned by an abortive attempt to reduce a dislocation of the shoulder, so that the patient's condition has been much worse than before. In such cases, when the bone is replaced, it is often rather

an evil than a good, from the violence of the extension.

In those instances, in which the bone remains in the axilla, in dislocations of the shoulder, a serviceable limb, and very extensive motions of it, may be regained, although reduction has not been effected. Captain S_____, who dislocated his shoulder four years ago, called to show me how much motion he had recovered, although the arm still remained unreduced.

In cases of unreduced dislocation, the only course which the surgeon can adopt, after the inflammation which the injury produces has subsided, is to advise motion of the limb, and friction of the injured part:—The former, to produce a new cavity for the head of the bone, to assist in forming a new ligament, and in restoring action to muscles, which would otherwise lose it by repose;—the latter, to promote absorption, and remove the swelling and adhesions which the accident has produced.

PLATE I.

FIG. 1. Dislocation of the femur upwards upon the dorsum ilii. The limb is shortened,—the hip projecting,—the knee and foot turned inwards, with the toes resting on the metatarsus of the other foot. The head of the bone is thrown back, and the trochanter major forwards.

Fig. 2. Dislocation of the femur downwards into the foramen ovale. The limb is lengthened,—the knee advanced, and separated from its fellow,—the toes are pointed,—the heel does not touch the ground,—the body is bent forward. This is the only accident of this joint, in which the leg is longer than its fellow.

Dislocation of the femur upwards into the acetabular notch. The leg is shorter,—the patella is an inch to an inch above the other,—turned a little inwards, with the great toe against the ball of the great toe of the limb. In thin persons, the head of the bone may be felt a little above and behind the pubum; more especially if the knee be bent.

Fig. 4. Dislocation of the femur upwards upon the pubes:—a prominence at Poupart's ligament, where the head of the bone is situated,—the knee is turned out, and widely separated from its fellow,—the leg is a little shorter, one patella being about an inch higher than the other,—the toe touches the ground but the heel does not.

PARTICULAR DISLOCATIONS.

CHAPTER I.

DISLOCATIONS OF THE HIP-JOINT.

Anatomy of the joint THE acetabulum of the hip-joint is deepened by a cartilaginous ridge, which surrounds its brim; and although in the skeleton it is not a complete cup, yet it is rendered such in the living subject, by an additional portion of cartilage, which fills up a depression in the bone in the inferior and anterior part of the cavity.

Ligaments. The ligaments are two: the capsular from the edge of the acetabulum, and passing head and neck of the bone, is inserted into of the os femoris at the root of the trochanter. It is much more extensive upon the on the posterior portion of the neck of the bone. The inner side of this ligament is a secreting surface, producing the synovia; and a prolongation of it towards the head of the bone is covered with a similar secreting surface.

The anterior surface of the neck of the thigh-bone. The capsular ligament is received into a line, extending from the trochanter major to the tro-

chanter minor. The synovial secreting surface is reflected towards the head of the bone, and the ligament is reflected close on the neck of the bone, to form the periosteum; whilst its fibres are blended in with the common periosteum, below the insertion of the ligament, into the bone.

On the posterior surface the capsular ligament is received upon the neck of the bone, nearly midway between the edge of the head of the bone and the trochanter major. The common periosteum on the neck of the bone blends in with the reflected ligament, to form the periosteum of the neck of the bone within the capsule.

The ligamentum teres is contained within the capsular ligament, and proceeds from a depression in the lower and inner part of the fixed in a hollow upon the inner bone: it has a tendency to prevent directions, but particularly the wards; for when this dislocation are widely separated from each other and the head of the thigh-bone were slipping from its socket, but that vents it:—an example of its use principal reason of its formation.

Mode of dislocation. The thigh-bone is liable in four directions:—First, upwards dorsum of the ilium. Secondly, through the foramen ovale. Thirdly, b:

wards, or into the ischiatic notch ; and, Fourthly, forwards, and upwards, or upon the body of the pubes. A dislocation downwards and backwards, has been described by some surgeons, who have had opportunities for observation ; but I have to remark, that no dislocation of that description has occurred at St. Thomas's or Guy's Hospital, within the last thirty years, or in my private practice ; and although I would not deny the possibility of its occurrence, yet I am disposed to believe that some mistake has arisen upon this subject.

SECTION I.

DISLOCATION UPWARDS, OR ON THE DORSUM ILII.

Dislocation on Dorsum illi. This dislocation is the most frequent of which happen to the hip-joint ; and the following signs of its existence :

The dislocated limb, is from one inch to two inches and a half shorter than the other, seen by comparing the malleoli. The foot is bent at right angles with the leg, the toe rests upon the tarsus of the other, and foot are turned inwards, and the limb advanced upon the other. When the limb is to separate the leg from the other, it is accomplished, for the limb is firmly fixed in its new situation, so far as regards its motion.

outwards; but the thigh can be slightly bent across the other. If the bone be not concealed by extravasation of blood, the head of the thigh-bone can be perceived during rotation of the knee inwards, moving upon the dorsum ilii; and the trochanter major advances towards its anterior and superior spinous process, so as to be felt much nearer to it than usual. The trochanter is less prominent than on the opposite side, for the neck of the bone and the trochanter rest in the line of the surface of the dorsum ilii; and upon a comparison of the two hips, the roundness of the dislocated side will be found to have disappeared. A surgeon, then, called to a severe and recent injury of the hip-joint, looks for a difference in length, change of position inwards, diminution of motion, and decreased projection of the troch.

Distinction from fracture of the neck of the femur. The accident with which upwards is liable to be the fracture of the neck of the thigh-bone, the capsular ligament. Yet the mark arc, in general, sufficiently strong error in a person commonly attentive. of the neck of the thigh-bone, the knee generally turned outwards; the trochanter upwards and backwards, resting upon the dorsum ilii; the thigh can be readily bent across the abdomen, although with some pain; the limb, which is shortened according to the condition of the accident, from one to two

contraction of the muscles, can be made of the length of the other by a slight extension; and when the extension is abandoned, the leg is again shortened. If, when drawn down, the limb is rotated, a crepitus can often be felt, which ceases to be perceived, when rotation is performed under a shortened state of the limb. Fracture of the neck of the thigh-bone, within the capsular ligament, rarely occurs but in advanced age, and it is the effect of the most trifling accident, owing to the interstitial absorption which this part of the bone undergoes at advanced periods of life. Fractures externally to the capsular ligament, occur at any age, and they are easily distinguished by the crepitus which attends them, if the limb be rotated and the trochanter compressed with the hand. The position is the same as in fractures within the ligament. Fractures of the neck of the thigh-bone are frequent accidents when compared with dislo-

Diseases of the hip-joint can scarcely be confounded with dislocations from violence, who are ignorant of anatomy, and who are superficial observers. The gradual progress of the disease, the pain in the knee, with the limitation at first, and real shortening of the capacity for motion, yet the pain in the extreme of rotation, as well as of flexion and extension, are marks of difference which would impress a careless observer. The consequences

of a disease of this kind, when it has existed a great length of time, are ulceration of the ligaments, acetabulum, and head of the bone, which allow of such a change of situation of parts, as sometimes to give to the limb the position of dislocation ; but the history of the case at once informs the medical attendant of the nature of the disease.

Cause. This dislocation may be caused by a fall when the knee and foot of the patient are turned inwards, or by a blow whilst the limb is in that position ; and the head of the bone is thus displaced upwards, and turned backwards.

Treatment. In the reduction of this dislocation, the following plan is to be adopted :—take from the patient from twelve to twenty ounces of blood, or even more, if he be a very strong man; place him in a warm bath, at the heat gradually increase to 110° , until During the time he is in the warm bath, grain of tartarized antimony every ten minutes; he feels some nausea; then remove him from the bath and put him in blankets: he is placed between two strong posts and asunder, in which two staples are fixed, may be screwed into the floor, and laid upon it. My usual method is, to have a table covered with a thick blanket, then a strong girt is passed between the legs and thigh, and this is fixed to one of the

A wetted linen roller is tightly applied just above the knee, and upon this a leathern strap is buckled, having two straps with rings at right angles with the circular part. The knee is to be slightly bent, but not quite at a right angle, and brought across the other thigh a little above the knee of that limb. The pulleys are fixed in the other staple, and in the straps above the knee. The patient being thus adjusted, the surgeon slightly draws the string of the pulley, and when he sees that every part of the bandage is upon the stretch, and the patient begins to complain, he waits a little to give the muscles time to fatigue; he then draws again, and when the patient suffers much, again rests, until the muscles yield. Thus he gradually proceeds until he finds the head approach the acetabulum. When it is near the rim of that cavity, he gives the pulley a violent pull, and desires him to preserve the same position, and the surgeon then rotates the limb gently, but not with a violence to jar in the muscles, and in this act the head will snap into its place. In general, it does not snap into its socket when the pulleys are drawn, because the muscles are so much relaxed that they have not sufficient tone remaining to act with violence, and the surgeon must reduce it by loosening the bandage, and adjusting the length of the limbs.

It often happens that the bandages get loose before the extension is completed, an accident which should be guarded against as much as possible, by having them well secured at first; but if they require to be renewed, this should be expeditiously performed, to prevent the muscles having time to recover their tone.

It is sometimes necessary to lift the bone, by placing the arm under it, near the joint, when there is difficulty in bringing it over the lip of the acetabulum; or a napkin may be passed under it as near the head of the bone as possible, and by its means an assistant may raise it. After the reduction, in consequence of the relaxed state of the muscles, great care is required in removing the patient to his bed.

I have seen reduction of the bone effected, everywhere the extension was not made in the best po' direction; for when the muscles have not hr' to settle, they will allow the bone to be restc its socket, even when extension is made in not the most favourable for its reduction by any means subscribe to the method the late Mr. Hey, although no person respect for his talents, more highly e acquirements, or is more disposed to pu of the profession in the mode which he s adopted. The direction which he gave

the case which he has represented of this accident, was one little calculated to succeed, where the means were not used immediately after the injury had been sustained. But I state this with great deference, because I am not sure, that in all respects, I understand the description of the method which he adopted; nor do I think that I should be able, from that description, to be certain that I was pursuing the means by which he succeeded.

I may here observe, and I trust without ostentation, that the plans which I have recommended, are the result of considerable experience; that they have been successful in a great number of cases; and that they have very rarely failed, under the most disadvantageous circumstances: they may require a , from some slight difference in the is will only be an exception to a gene- ill very rarely occur.

ng cases will serve as illustrations of treatment of dislocations on the dor-
irst of them points out in a striking ls that ensue when dislocation of the ins unreduced, and the advantages use of pulleys in effecting its reduc- also that such dislocation may happen lthy man, even after he has attained

Case. James Ivory, aged sixty-two, of Pot-tensend, Herts, on the 7th of Feb. 1810, was working in a clay-pit about twenty-five feet below the surface of the earth, when a large quantity of clay fell in upon him, while he was in the act of stooping with his left knee bent rather behind the other ; and he was in this position buried under the earth. Being soon removed from this perilous situation, and carried home, a surgeon was sent for, who, discovering the accident to be a dislocation, directly employed some men to extend the limb, whilst he attempted to push the head of the bone into the acetabulum ; but all his efforts were unavailing, as, unfortunately for the patient, pulleys were not employed. The appearances of the limb at present, when nine years have elapsed since the accident are these : the limb is three inches and a half shorter than the other, and the patient is obliged to wear a shoe having an additional sole of three inches on that side, which lessens, it does not prevent, his halt in walking. V stands, the foot of the injured limb rests on the other ; the toes are turned inwards, and which is advanced upon the other, is a and rests upon the side of the patella limb, and upon the vastus internus my bent, and cannot be completely extended from the unemployed state of several of is very much wasted ; but the semi-tendinous membranosus, and biceps, owing to

state of the limb, form a considerable rounded projection on the back part of the thigh. The trochanter major is seven-eighths of an inch nearer to the spine of the ilium of the injured side than of the other. On viewing him behind, the trochanter major is seen projecting on the injured side much further than on the other; the situation of the head of the bone on the dorsum ilii is easily perceived; and when the limb is rotated inwards, it is still more obvious. The spinous processes of the ilia are of an equal height. In the sitting posture, the foot is turned very much inwards, and the knee is placed behind the other, whilst the toe only reaches the ground. If fatigued, he experiences pain in the opposite hip, and in the thigh of the injured limb.

an has an arduous task to gain our, as he cannot stoop but with lty, and is therefore obliged to ments which least require that e attempts to take any thing from ls the knee of the injured limb at ie thigh, and throws it far back. r a few seconds upon the dislocated lve months before he could do so. "ainful to him to lie on the injured tout any apparent cause, is much es than at others. When sitting is fæces, he is obliged to support

himself by resting the injured knee against the tendo Achillis of the other leg, placing his right hand on the ground. He now walks with two sticks ; at first he employed crutches, and these he used for twelve months, after which he was enabled to trust to one crutch and a stick, until his limb acquired greater strength. In getting over a stile, he raises the injured limb two steps, and then turns over the sound limb ; but this he cannot accomplish when the steps are far apart ; and he is frequently obliged either to turn back, or to take a circuitous route. When lying with his face downwards, the dislocated hip projects very much. He sometimes falls in walking, and would very frequently do so, but that he takes extreme care, as the least check to his motion throws him down. The knee is bent, and the shortening of the limb partly depends upon that circumstance.

The following cases illustrate the method
duction detailed in the preceding pages, and
strong colours, the advantages to be deriv
constitutional treatment, and the use of pru

Case. John Forster, aged twenty
was admitted into the Chester Infirmary
1818, with a dislocation of the thigh or
iliac, occasioned by a cart passing over
Upon examination, I found the leg shor
other, and the knee and foot turned in

patient being firmly confined upon a table, I extended the limb by pulleys, for fifty minutes, without success, and he was returned to bed for three hours; after which he was put in the warm bath for twenty minutes, and the extension was repeated for fifteen minutes unsuccessfully; I therefore took twenty-four ounces of blood from him, and gave him forty drops of tinct. opii. Continuing the extension, but not succeeding in producing faintness, I gave small doses of a solution of tartrate of antimony, which, in a quarter of an hour, produced nausea; in ten minutes afterwards, I succeeded in reducing the limb, and in less than a fortnight he left the infirmary quite well. Unfortunately, he began to work hard immediately, and brought

on of the hip, of which he did not tell me.

Lee, aged thirty-three, of a strong constitution, in passing over a foot-bridge, fell from a height of about four or five feet, and dislocated his left hip. I saw him three inches shorter than the other, turned in, the foot directed over the knee, and the trochanter major brought into contact with the process of the ilium. On laying hold of the femur, the head of the femur and trochanter were distinctly seen on the dorsum of the ilium, leaving no doubt of the nature of the dislocation.

the injury. With the assistance of a neighbouring practitioner, I immediately set about to reduce it ; a girt was applied between the legs, and a bandage over the knee, to fix the pulleys, &c., in the usual manner. I then made the extension downwards and inwards, crossing the opposite thigh two thirds downwards ; and immediately when the extension was commenced, I gave him a solution of two grains of tartar emetic, which was repeated five times at intervals of ten minutes, but it produced very slight nausea. I shortly after bled him to sixty ounces without syncope ; and after keeping up the extension gradually for about two hours, with all the force one man could employ with the pulleys, we found the limb as long as the opposite ; we then endeavoured to lift the head of the bone over the acetabulum, by means of a towel under the thigh and over one of our heads at the same time rotating the limb outwards with the force we were able to exert ; the foot at became somewhat turned out, and the head bone to be less distinctly felt, and in about hour we heard a grating of the head of the when the man instantly exclaimed it w and, upon examination, finding the foot the limb of its natural length, and no the head of the bone on the dorsum ilii, we it must be within the acetabulum, and d any further violence, put the man to his legs together : his foot immediately

ble, which it had not been before since the accident, and he altogether felt easier. A large blister was applied over the trochanter, and he slept well in the night, and complained of pain only in the perineum and just above the knee, where the bandages had been applied ; there was no subsequent fever, nor any unpleasant symptom whatever.

In a few days the man could bear slight flexion and extension without pain, and in a week some degree of rotation ; the limb became gradually stronger, and the power of motion so increased, that on the twelfth day he could by himself bring the thigh at right angles with the body. He was now taken out of bed, and bandages were applied round the thigh and pelvis, and he could stand perfectly upright, so as to walk with his heel on the ground with the assistance of crutches : and, from exercise, he grew so rapidly stronger, that on the twenty-second day he left off one crutch, and on the twenty-fifth the other. In a month he was able to walk without a stick ; and in five weeks, having particular business, he walked nearly twenty miles, perfectly upright, and without the least limping.

Collumpton, Devon,
Jan. 27, 1820.

S. NOTT.

The following case forms a striking contrast to the preceding, and to some of those hereafter related.

Case. I was desired to visit a man aged twenty-eight years, who, by the overturning of a coach, had dislocated his left hip more than five weeks before; and who had been declared not to have a dislocation, although the case was extremely well marked. His leg was full two inches shorter than the other; his knee and foot were turned inwards; and the inner side of the foot rested upon the metatarsal bones of the other leg. The thigh was slightly bent towards the abdomen, and the knee was advanced over the other thigh. The head of the thigh-bone could be distinctly felt upon the dorsum of the ilium; and when the two hips were compared, the natural roundness of the dislocated side had disappeared. I used only mechanical means in my attempts at reduction; and although I employed the pulleys, and varied the direction of repeated extensions, I could not succeed in replacing the bone, and this person returned to the country with the dislocation unreduced.

The following case was communicated by Mr. Norwood, surgeon, Hertford.

Case. William Newman, a strong muscular man, nearly thirty years of age, was admitted into Guy's Hospital, on Wednesday, December 4th, 1812, under the care of Mr. Astley Cooper, for a dislocation of the hip-joint. In springing from the shafts of a waggon, on Thursday, November 7th, his foot slipped, and his hip was driven against the wheel

with considerable force. He immediately fell, and being found unable to walk, was carried to Kingston Workhouse, which was near the place where the accident happened. On the evening of that day, he was examined by a medical man, but the nature of the accident was not ascertained. He remained at Kingston until the 30th of November, and was then removed to Guildford, his place of residence, and from thence, on the 4th of December, to Guy's Hospital. On examination, the head of the thigh-bone was found resting on the dorsum ilii ; the trochanter was thrown forwards towards the anterior superior spinous process of the ilium. The knee and foot were turned inwards, and the limb shortened one inch and a half; the great toe rested upon the metatarsal bone of the other foot, and there was but little motion in the limb.

On Saturday, the 7th of December, being thirty days after the accident, an extension was made to reduce the limb ; and previously to the application of the bandage, he was bled to twenty-four ounces from his arm ; in about ten minutes after this he was put into a warm bath, where he remained until he became faint, which happened in fifteen minutes ; he then had a grain of tartarized antimony given him, which was repeated in sixteen minutes, as the first dose did not produce nausea. The most distressing nausea was now quickly produced, but he did not

vomit ; and while under the influence of this debilitating cause, he was carried into the operating theatre in a state of great exhaustion. Being placed on a table on his left side, the bandage was applied in the usual manner to fix the pelvis, and the pulleys were fastened to a strap around the knee ; the thigh was drawn obliquely across the other, not quite two-thirds of its length downwards, and the extension was continued for ten minutes, when the bone slipped into its socket. The man was discharged from the hospital in three weeks from the period of his admission, making rapid progress towards a recovery of the perfect use and strength of the limb.

For the history of the following case, I am obliged to Mr. Thomas, apothecary to St. Luke's Hospital, who attended the case while acting as dresser at St. Thomas's Hospital.

Case. William Chapman, aged fifty years, was admitted into St. Thomas's Hospital, on Thursday, September 10th, 1812, with a dislocation of the left hip upon the dorsum ilii, which was occasioned by the mast of a ship falling upon the part and throwing him down, on the Wednesday *six weeks* prior to his admission into the hospital. It was reduced on Friday, the 11th of September, in the following manner. The patient was bled by opening a vein in each arm, and thirty-four ounces of blood were taken away. He was then put into a warm bath, and a

grain of tartarized antimony given to him, which was repeated every ten minutes; this, with the previous means, produced fainting and nausea.

The patient was then placed on a table on his right side, and a girt was carried between his thighs and over his pelvis, so as completely to confine it; a wetted roller was applied above the knee, and upon it a leathern belt, with rings for the pulleys. The extension was then made in a direction causing the dislocated thigh to cross the other below its middle, and in half an hour the reduction was accomplished.

The three following cases shew that we are not to despair of success, even after a considerable time from the accident has elapsed.

Case. Mr. Mayo has mentioned the case of William Honey, who came into the hospital in August, 1812: the dislocation had taken place seven weeks before, and was reduced the day after his admission; he was discharged, cured, on the 18th of November. This was a dislocation on the dorsum ilii.

Case. Mr. Tripe, surgeon at Plymouth, has sent to the Medico-Chirurgical Society, an account of a case of dislocation of the thigh-bone on the dorsum ilii, which had happened seven weeks and one day prior to his making an extension, in which he was so fortunate as to succeed in restoring the bone to its natural situation.

The following instances prove, indeed, that the dislocation on the dorsum ilii may be reduced without

pulleys ; but they shew at the same time, how desirable the pulleys would have been, especially in the two first instances.

Case. William Piper, aged twenty-five years, sustained an injury from the wheel of a cart, laden with hay, which passed between his legs and over the upper part of his right thigh. Mr. Holt, surgeon at Tottenham, was sent for nearly a month after the accident had happened ; he found him in great pain, attended with fever, and much local inflammation and tension. He bled him largely, purged him freely, and applied leeches. The leg was shorter than the other, and the head of the bone was seated upon the dorsum ilii ; the knee and foot were turned inwards.

As I visited Tottenham frequently at that time, Mr. Holt asked me to accompany him to see the man, and we agreed to the propriety of making a trial at reduction. Mr. Holt and myself, assisted by five strong men, exerted our best endeavours for that purpose. Repeatedly fatigued, we were several times obliged to pause and then renew our attempts. At length, exhausted, we were about to abandon any further trial, but agreed to make one last effort ; when, at fifty-two minutes after the commencement of the attempt, the bone slipped into its socket.

Case reduced without pulleys. I also, in a case which I attended with Mr. Dyson, in Fore Street, succeeded in reducing the limb without the pulleys ; but the violence used

was so great, and the extension so unequal, (our fatigue being nearly as severe as that of the patient,) that I am confident no person who had used pulleys in dislocation of the hip, would have recourse to any other mode, excepting in dislocation into the foramen ovale.

Case. Mary Bailey, aged seven years, was admitted into Guy's Hospital, June 16th, 1819, under the care of Mr. Astley Cooper, for a dislocation of the os femoris upwards on the dorsum ilii. This accident was occasioned by the child swinging on the shaft of a cart, which, being insecurely propped, suddenly gave way, and she fell to the ground upon her side. The nature of the accident was exceedingly evident ; the limb on the dislocated side was at least two inches shorter than the other ; the toe rested on the tarsus of the opposite foot, and was turned inwards ; the knee was also inverted and rested on the other. The child was admitted into the hospital at half-past five in the afternoon, the accident having happened a little more than half an hour before. Where so little resistance was expected the pulleys appeared unnecessary, and towels were substituted, one being applied above the knee, and the other between the pudendum and thigh ; then, bending the knee, and bringing the thigh across the other just above the knee, gradual extension was made, and in about four minutes the head of the bone suddenly snapt into its socket. On the seventh day the

child was walking in her ward, and suffered little inconvenience.

To Mr. Daniel, one of Mr. Lucas's dressers, I am obliged for the foregoing particulars; he having reduced the limb in the presence of many of the students.

Case reduced by extension at the ankle. William Sharpe, an athletic young man, in wrestling, received a fall; his antagonist falling with and upon him, their legs were so entangled that he cannot say how he came to the ground. He complained of great pain in the hip, and was incapable of rising. About twenty minutes after the accident, I found him lying on his belly in the field where it had occurred, and the left limb in a trifling state of abduction, shortened, and the knee and foot turned inwards, the prominency of the trochanter gone, and the head of the bone obscurely felt on the dorsum ilii. He was conveyed home, and in order to reduce the dislocation, for such I considered it, I placed the man on his right side diagonally across a four-post bedstead. The centre of a large sheet, rolled up, was passed in front and behind the body, and fastened to the upper bed-post, as low as possible. The centre of a napkin, rolled in like manner, was then applied upon the dorsum ilii, between its crista and the dislocated bone; and each extremity being brought under the sheet, forwards and backwards, was reflected over it and tied in the centre, by which means I hoped to keep the pelvis

secure; the counter-extending force was applied above the ankle, (it appearing to me to interfere less with the muscles upon the thigh,) first, by rolling round a wetted towel, and then placing upon this the end of a long or jack-towel: three men were now directed to pull gradually and steadily; and when I perceived that the head of the femur was brought down to the edge of the acetabulum, I raised it a little with my clasped hands, placed under the upper part of the thigh, and immediately the head of the bone entered the cotyloid cavity with a smart snapping noise. The man had considerable pain about the hip and knee for some time, but is now quite well*.

Case, dislocation
of the thigh upon
the dorsum lili,
with fracture of
the thigh-bone

Abraham Harman, aged thirteen years, a patient under Mr. Forster, in Guy's Hospital, gave the following account of his accident.—About four months since, he drove his master's horses to a chalk-pit; he went down into the pit to pack the chalk, and to break it into small pieces, and whilst he was thus occupied, the side of the pit gave way, and a large piece of chalk striking him violently on the hip, knocked him down. Being immediately taken to a neighbouring public-house, a surgeon was sent for. The thigh was discovered to be fractured near its middle, but very considerable contusions prevented the dislocation from being at first discovered.

* The particulars of this case were furnished by Mr. Oldnow, of Nottingham, in whose practice it occurred.

Fomentation and other means of reducing the swelling at the hip being employed, it was ascertained that the thigh was also dislocated, and some attempts were made to reduce it; but the fracture would not then bear the extension, and the boy was sent to the hospital. No attempts have been made to reduce the bone.

This case presented unusual difficulties; and the probability is, that dislocation thus complicated with fracture, will, generally, not admit of reduction; as an extension cannot be made, until three or four months have elapsed from the accident, and then only with strong splints upon the thigh, to prevent the risk of disuniting the fracture.



PLATE II.

FIG. 1. A dislocation into the foramen ovale, which had not been reduced, showing the formation of a new socket for the head of the bone, which admitted of motion to a considerable extent.

- a.* Ilium.
- f.* Sacrum.
- g.* Os femoris.
- h.* The new acetabulum, formed in the foramen ovale, which so completely enclosed the head of the thigh bone that it became impossible to remove it, unless a portion of the new acetabulum was broken away. It was lined by ligamentous substance, on which the head of the bone moved to a considerable extent.
- i.* The original acetabulum, situated above the level and to the outside of the new cavity.

Fig. 2. A side view of the external surface of the os innominatum, showing a dislocation of the femur into the ischiatic notch.

- a.* Ilium.
- b.* Ischium.
- c.* Pubis.

- d.* Trochanter major, covering and concealing the acetabulum.
- f.* Head of the femur, thrown into the ischiatic notch, and situated between the posterior inferior spinous processes of the ilium and the spinous process of the ischium.
- g.* A new capsular ligament, formed around the head of the bone, and composed of cellular membrane condensed by inflammation.
- h.* Ligamentum teres, which had been torn through in the dislocation, and the original capsular ligament.

SECTION II.

DISLOCATION DOWNWARDS, OR INTO THE FORAMEN OVALE.

Anatomy. The foramen ovale is formed by the junction of two bones, the ischium and the pubes ; it is situated below the acetabulum, and is somewhat

nearer the axis of the body. It is filled by a ligament which proceeds from the edges of the foramen, and has an opening in its upper and anterior part, to permit the passage of the obturator blood-vessels, and the obturator nerve. It is covered on its external and internal surface by the obturator externus, and obturator internus muscles.

Mode of accident. This dislocation happens when the thighs are widely separated from each other. The ligamentum teres and the lower part of the capsular ligament are torn through, and the head of the bone becomes situated in the posterior and inner part of the thigh, upon the obturator externus muscle.

It has been erroneously supposed, that the ligamentum teres is not torn through in this dislocation ; because in the dead body, when the capsular ligament is divided, the head of the bone can be drawn over the lower edge of the acetabulum without tearing the ligamentum teres. But the dislocation in the foramen ovale happens whilst the thighs are widely separated, during which act the ligamentum teres is upon the stretch ; and when the head of the bone is thrown from the acetabulum, this ligament is torn through before it entirely quits the cavity.

SYMPTOMS.

The limb is in this case two inches longer than the other. The head of the bone can be felt by pressure of the hand, upon the inner and upper part of the

thigh towards the perineum, but only in very thin persons. The trochanter major is less prominent than on the opposite side. The body is bent forwards, owing to the tension of the psoas and iliacus internus muscles. The knee is considerably advanced if the body be erect ; it is widely separated from the other, and cannot be brought, without great difficulty, near the axis of the body to touch the other knee, owing to the extension of the glutei and pyriformis muscles. The foot, though widely separated from the other, is, generally, neither turned outwards nor inwards, although I have seen it varying a little in this respect in different instances ; but the position of the foot does not in this case mark the accident. The bent position of the body, the separated knees, and the increased length of the limb, are the diagnostic symptoms. The position of the head of the bone is below, and a little anterior to, the axis of the acetabulum ; and a hollow is perceived below Poupart's ligament.

DISSECTION.

We have an excellent preparation of this accident in the collection at St. Thomas's Hospital, which I dissected many years ago. The head of the thigh-bone was found resting in the foramen ovale, but the obturator externus muscle was completely absorbed, as well as the ligament naturally occupying the foramen ; which is now entirely filled by bone. Around

the foramen ovale, bony matter was deposited so as to form a deep cup, in which the head of the thigh-bone was inclosed, but in such a manner as to allow of considerable motion; and the cup thus formed, surrounded the neck of the thigh-bone without touching it, and so inclosed its head, that it could not be removed from its new socket without breaking its edges. The inner side of this new cup was extremely smooth, not having the least ossific projection at any part to impede the motion of the head of the bone; which was only restrained by the muscles from extensive movements. The original acetabulum was half filled by bone, so that it could not have received the ball of the thigh-bone if an attempt had been made to return it into its natural situation. The head of the thigh-bone was very little altered; its articular cartilage still remained; the ligamentum teres was entirely broken, and the capsular ligament partially torn through; the pectineus and adductor brevis muscles had been lacerated, but were united by tendon; the psoas and iliacus internus, the glutei and pyriformis muscles, were all upon the stretch. Nothing can be more curious, or, to the surgeon and physiologist, more beautiful, than the changes produced by this neglected accident, exemplifying, as they do, the resources of nature in producing restoration.

REDUCTION.

The reduction of this dislocation is in general very

easily effected. If the accident has happened recently, it is requisite to place the patient upon his back, to separate the thighs as widely as possible, and to place a girt between the pudendum and the upper part of the luxated thigh, fixing it to a staple in the wall. The surgeon then puts his hand upon the ankle of the dislocated side, and draws it over the sound leg, or, if the thigh be very large, behind the sound limb, and the head of the bone slips into its socket. Thus, I saw a dislocation reduced, which had happened very recently, and which was subjected to an extension in Saint Thomas's Hospital, almost immediately after the patient's admission. In a similar case, the thigh might be fixed by a bed-post received between the pudendum and the upper part of the limb, and the leg be carried inwards across the other. But in general it is required to fix the pelvis by a girt passed around it, and crossed under that which passes around the thigh, to which pulleys are to be attached, otherwise the pelvis will move in the same direction with the head of the bone.

In those cases in which the dislocation has existed for three or four weeks, it is best to place the patient upon his sound side; to fix the pelvis by one bandage, and to carry under the dislocated thigh another bandage, to which the pulleys are to be affixed perpendicularly; then to draw the thigh upwards, whilst the surgeon presses down the knee and foot, to prevent the lower part of the limb being drawn with

the thigh-bone. Thus the limb is used as a lever of very considerable power. Great care must be taken not to advance the leg in any considerable degree, otherwise the head of the thigh-bone will be forced behind the acetabulum into the ischiatic notch, from whence it cannot be afterwards reduced.

Case. A gentleman was thrown from his horse on the 4th of January, 1818, by the animal suddenly starting to the right side ; and whilst he endeavoured to keep his seat by the pressure of the right thigh against the saddle, he was thrown, and from the fall received a severe contusion upon his head, which produced alarming symptoms. On the following day it was observed that the right thigh was useless, and that the knee was raised and could not be brought into a straight line with the other, having at the same time a direction outwards, which required it to be tied to the other knee : the symptoms of injury to the head precluded, at this time, the attempt at reduction. In fourteen days he was so far recovered that he was able to rise from his bed, and in a month he began to walk with crutches.

On November 1st, 1818, I first saw him ; and the appearances of the injured limb were then as follow :—the thigh was longer than the other by the length of the patella ; the knee was advanced ; and when he was in the recumbent posture, the injured leg could not be drawn down to the same length with the other. The upper part of the thigh-bone

was thrown backwards, so as to render the hollow of the groin on the injured side deeper than that on the other. The toes were rather everted, but when the body was erect, were capable of resting on the ground, though the heel was not. The head of the bone could not be felt, and the trochanter was much less prominent than usual. When the upper part of the thigh-bone was pressed against the new acetabulum, and moved, there was a sensation like that of friction between two cartilaginous surfaces, which, although not easily described, is readily distinguished from the crepitus occasioned by a fractured bone. In a sitting posture the injured leg was two inches longer than the other; and to that degree the knee was projected beyond the sound one. In progression the knee was bent; and the body being thrown forwards the patient rested chiefly upon his toe, and halted exceedingly in walking. The sartorius and gracilis muscles were very much put upon the stretch. At first he suffered much from pain in the dislocated hip and thigh, but is now free from pain, unless when he attempts to stand on that limb only. His toe, at first, was with difficulty brought to the ground, but he is now improved in walking; for when he first made trial, with the assistance of a crutch and stick, he could not exceed half a mile, but he is now able to walk two miles. In flexion his thigh admits of considerable motion, but he cannot extend it further than to bring the ham to the plane of the other pa-

tella. The knees cannot be brought together, but he advances one before the other in the attempt. He can sit without pain, but the jolting of a carriage hurts him exceedingly ; and the attempt to sit on horseback produces excessive suffering. He cannot straighten his leg when his body is erect, nor can he stoop to tie his shoe on the injured side. Pain is produced by resting on that hip in bed. No attempt was made to reduce the limb ; the injury to the head might have rendered it dangerous in the commencement, and at the time when I saw him there was no chance of success.

CASE.
Dislocation of
the right femur
into the foramen
ovale. Mr. Thomas Clarke, a farmer, about fifty years of age, was driving home in

his cart from market, when the horse took fright and ran away with him. The following is the account he gives of the manner in which the accident happened :—in his endeavour to stop the horse, he fell over the front of the cart on his face, and the knee struck against some part of it in the act of falling, by which means the thighs were separated ; the wheel, he also states, passed over his hip.

My friend, Mr. Potter, of Ongar, in Essex, in company with Mr. Daniell, to whom I am indebted for the particulars of the case, were consulted between two and three weeks after the accident had happened.

The nature of the accident was extremely evident ;

the limb was fully three inches longer than the other, the body bent forwards, the knees separated, and the foot rather inclined outwards ; these were the leading diagnostic marks. Having clearly ascertained the position of the dislocated limb, they determined on the following morning to attempt its reduction ; and the following were the means employed.

" Our first object was to produce relaxation ; and finding the patient was sufficiently strong to bear the plan usually recommended in cases of dislocation, where much resistance is expected, we drew away some blood from the arm ; this, however, was not sufficient for our purpose, and a solution of tartar emetic, which we had brought with us, was administered. The patient was laid upon his side, close to the edge of the bed, (that being the most convenient place,) a girt was passed round the pelvis, and carried through the frame of the bedstead, which completely prevented the possibility of the body moving whilst extension was going on ; a second girt was applied between the thighs, fixed to the one above, to which the pulleys were attached. Whilst extension was making, Mr. Potter took hold of the limb at the knee, and drew it rather upwards, and towards the sound thigh, occasionally rotating the limb. When the extension had been continued about ten minutes, the nausea produced by the tartar emetic was so excessive, that the patient begged of us to desist until

the morrow, observing, he felt so bad that he was fearful of falling off the bed : this exclamation, it hardly need be said, was a stimulus to our proceeding ; and in five minutes after, the limb was suddenly heard to snap into its original cavity. The patient was put to bed, a roller being applied round the pelvis, and at the end of five days, he felt so well that he left his room ; and at the expiration of a short time, suffered no other inconvenience than stiffness in the joint.”

Mischief from
improper extension Although a dislocation into the foramen ovale may be occasionally reduced by attempts made in a very inappropriate direction, yet instances have occurred which shew the mischief that may arise from an error in this respect.

SECTION III.

DISLOCATION BACKWARDS, OR INTO THE ISCHIATIC NOTCH.

Anatomical structure The space which is called the ischiatic notch is bounded above and anteriorly by the ilium, posteriorly by the sacrum, and inferiorly by the sacro-sciatic ligament. It is formed for the purpose of giving passage to the pyriformis muscle and to the sciatic nerve, as well as to three arteries, the glutæal, the ischiatic, and the internal pudendal. In

the natural position of the pelvis, it is situated posteriorly to the acetabulum, and a little above its level. When the head of the bone is thrown into this space, it is placed backwards and upwards, with respect to the acetabulum; therefore, although I call this the dislocation backwards, it is to be remembered that it is a dislocation backwards and a little upwards.

Nature of the accident. In this dislocation the head of the thigh-bone is placed on the pyriformis muscle, between the edge of the bone which forms the upper part of the ischiatic notch, and the sacro-sciatic ligaments, behind the acetabulum, and a little above the level of the middle of that cavity.

Detection difficult. This dislocation is the most difficult both to detect and to reduce: to detect, because the length of the limb differs but little, and its position, in regard to the knee and foot, is not so much changed as in the dislocations upwards: to reduce, because the head of the bone is placed deep behind the acetabulum, and it therefore requires to be lifted over the edge of that cavity, as well as to be drawn towards its socket.

SYMPTOMS.

The signs of this dislocation are;—that the limb is from half an inch to one inch shorter than the other, but generally not more than half an inch. That the trochanter major is behind its usual place, but is still remaining nearly at right angles with the

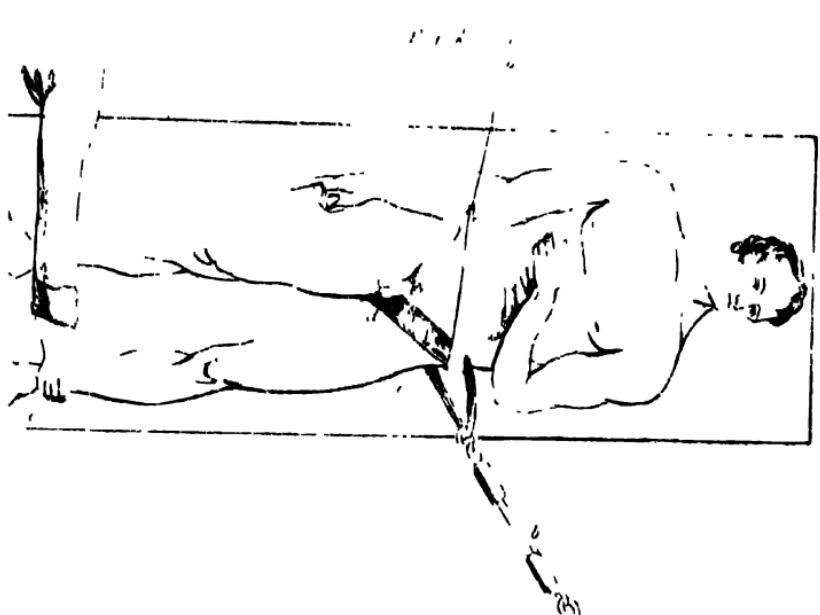
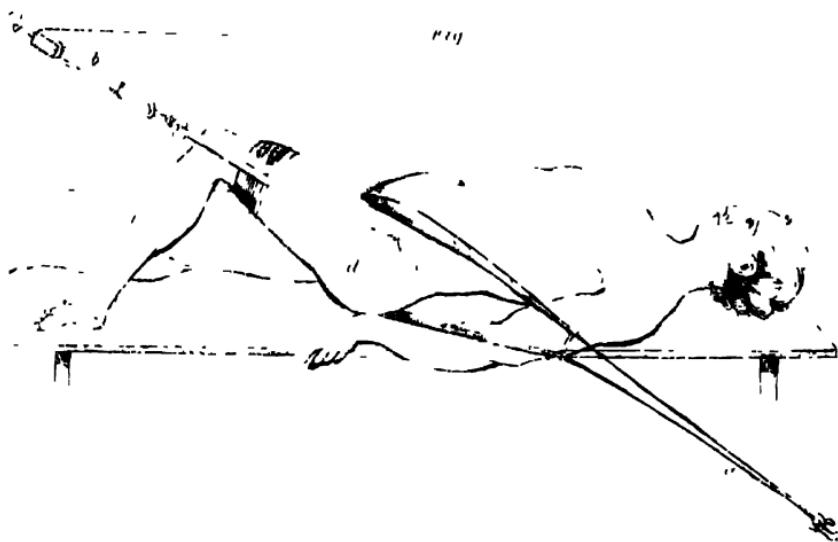


PLATE IV.

FIG. 1. Shows the mode of reducing dislocation upwards on the dorsum ilii.

- a. A bandage passed between the thighs to fix the pelvis.
- b. The pulley fixed above the knee, which is to be drawn obliquely across the sound thigh, at a point between its middle and lower third.
- c. The head of the bone upon the dorsum ilii.
- d. Acetabulum.

Fig. 2. Shows the mode of reducing dislocation downwards into the foramen ovale.

- a. A bandage to fix the pelvis.
- b. The pulley to draw the head of the femur outwards and upwards.
- c. The surgeon's hand grasping the ankle to draw the one leg across the other, and to draw the head of the bone outwards.
- d. The head of the bone in the foramen ovale.
- e. The acetabulum, into which the head of the bone is to be brought.

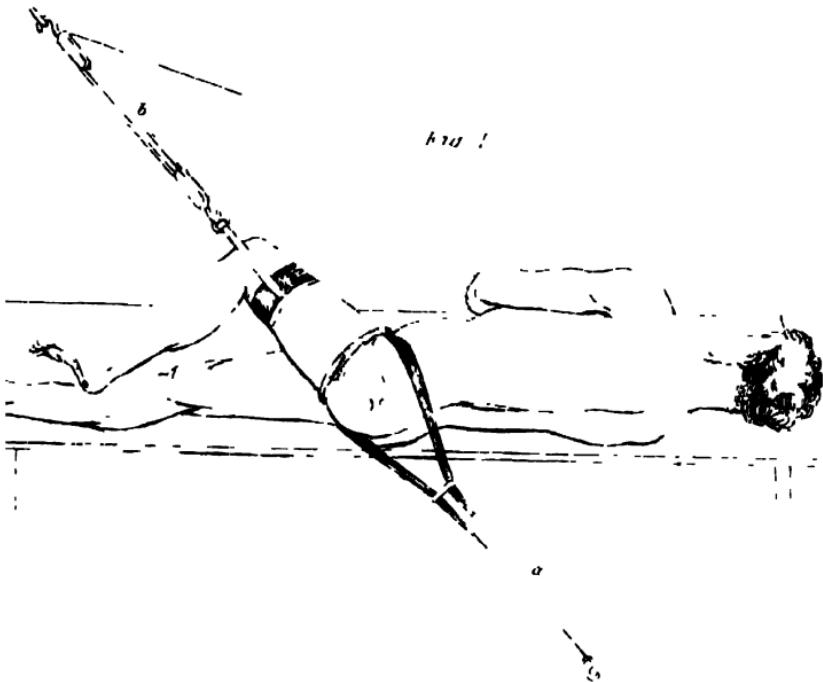


Fig. 1

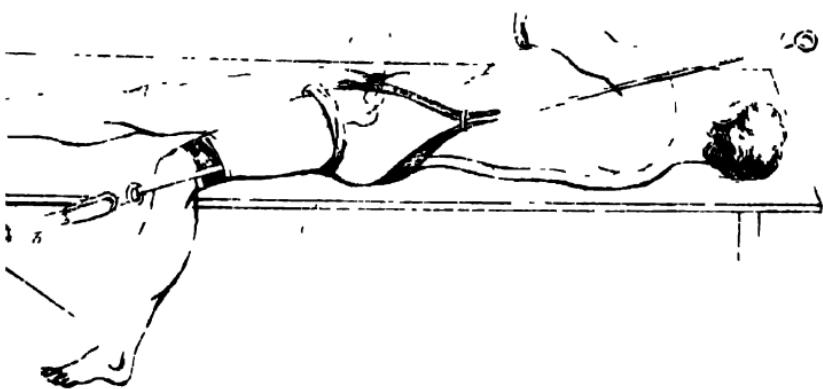


PLATE V.

FIG. 1. Shows the mode of reducing dislocation upwards and backwards into the ischiatic notch.

- a. A bandage passed between the thighs for the purpose of fixing the pelvis.
- b. The pulleys fixed above the knee, for the purpose of drawing the limb across the middle of its fellow.
- c. A band surrounding the upper part of the thigh, for the purpose of lifting the head of the bone into the acetabulum, when extension has been continued sufficiently long.
- d. The acetabulum.
- e. The head of the bone in the ischiatic notch.

Fig. 2. Shows the mode of reducing dislocation of the femur on the pubes.

- a. A bandage for the purpose of fixing the pelvis.
- b. The pulleys fastened above the knee, and drawing the limb downwards and backwards.
- c. A band, for the purpose of lifting the head of the bone during extension.

- d.* The head of the bone resting on the pubes.
- e.* The acetabulum; anteriorly and superiorly to which the head of the bone rests upon the junction of the pubes and ilium.

ilium, with a slight inclination towards the acetabulum. The head of the bone is so buried in the ischiatic notch that it cannot be distinctly felt, except in thin persons, and then only by rolling the thigh-bone forwards as far as the comparatively fixed state of the limb will allow. The knee and foot are turned inwards, but less than in the dislocation upwards; and the toe rests against the ball of the great toe of the other foot. When the patient is standing, the toe touches the ground, but the heel does not quite reach it. The knee is not so much advanced as in the dislocation upwards, but is still brought a little more forwards than the other, and is slightly bent. The limb is so fixed that flexion and rotation are in a great degree prevented.

DISSECTION.

We have a good specimen of this accident in the collection at St. Thomas's Hospital, which I met with accidentally, in a subject brought for dissection. The original acetabulum is entirely filled with a ligamentous substance, so that the head of the bone could not have been returned into it. The capsular ligament is torn from its connection with the acetabulum, at its anterior and posterior junction, but not at its superior and inferior. The ligamentum teres is broken, and an inch of it still adheres to the head of the bone. The head of the bone rests behind the acetabulum on the pyriformis

muscle, at the edge of the notch, above the sacro-sciatic ligaments. The muscle on which it rests is diminished, but there has been no attempt made to form a new bony socket for the head of the os femoris. Around the head of the thigh-bone a new capsular ligament is formed; it does not adhere to the articulatory cartilage of the ball of the bone which it surrounds, but could, when opened, be turned back to the neck of the thigh-bone, so as to leave its head completely exposed. Within this new capsular ligament, which is formed of the surrounding cellular membrane, the broken ligamentum teres is found. The trochanter major is placed rather behind the acetabulum, but inclined towards it relatively to the head of the bone.

In this specimen, from the appearance of the parts, the dislocation must have existed many years; the adhesions were too strong to have admitted of any reduction, and if reduced, the bone could not have remained in its original socket.

Cause. This species of dislocation is produced by the application of force, when the body is bent forward upon the thigh, or when the thigh is bent at right angles with the abdomen; when, if the knee be pressed inward, the head of the bone is thrown behind the acetabulum.

Reduction. The reduction of the dislocation in the ischiatic notch, is, in general, extremely difficult, and is best effected in the following manner:—the patient

should be laid on a table upon his side, and a girt should be placed between the pudendum and the inner part of the thigh, to fix the pelvis. Then a wetted roller is to be applied around the knee, and the leather strap over it. A napkin is to be carried under the upper part of the thigh. The thigh-bone is then to be brought across the middle of the other thigh, measuring from the pubes to the knee, and the extension is to be made with the pulleys. Whilst this is in progress, an assistant pulls the napkin at the upper part of the thigh with one hand, rests the other upon the brim of the pelvis, and thus lifts the bone, as it is drawn towards the acetabulum, over its lip. For the napkin I have seen a round towel very conveniently substituted, and this was carried under the upper part of the thigh, and over the shoulders of an assistant, who then rested both his hands on the pelvis, as he raised his body, and lifted the thigh.

Although the preceding is the method in which this dislocation is most easily reduced, yet I have seen a different mode practised ; and I shall mention it here, as it shews how the muscles opposing the pulleys, will draw the head of the bone to its socket, when it is lifted from the cavity into which it has fallen.

Case. A man, aged twenty-five, was admitted into Guy's Hospital, under the care of Mr. Lucas ; upon examination, the thigh was found dislocated backwards ; the limb scarcely differed in length from

the other, not being more than half an inch shorter; the groin appeared depressed; the trochanter was resting a little behind the acetabulum, but inclined upon it; the knee and foot were turned inwards, and the head of the bone could, in this case, be felt behind the acetabulum. An extension was made by pulleys in a right line with the body; at the same time, the trochanter major was thrust forward with the hand, and the bone returned in about two minutes into its socket with a violent snap.

The following case I received from Mr. Rogers, a very intelligent surgeon at Manningtree.

Case. William Dawson, aged thirty-four, on the 15th of August, 1818, while spending his harvest-home with several of his companions, became quarrelsome with one of them, who threw him down and trod upon him. Upon extricating himself, and endeavouring to rise, he found some serious injury to his right thigh, rendering him incapable of standing; in this state he was dragged by his associates for many hundred yards into a stable, where he lay till the next morning. I then saw him lying upon a mattress, with the hip and thigh, on the right side, prodigiously swollen and painful; and I was particularly struck with the appearances of the knee and foot on the same side, which were very much turned inwards, but the limb was scarcely shortened. I ordered him to be carefully conveyed home upon a shutter, supported by six men, a distance of about

half a mile. From the immense swelling and general enlargement of the whole of the thigh, and of the soft parts around the pelvis, it was impossible to ascertain exactly the state of the injury; but it was fully impressed upon my mind, that there was some unusual dislocation of the head of the thigh-bone. He was accordingly ordered immediately to lose blood, both by general and topical means, and emollient poultices were applied to the whole of the swollen parts; brisk purgatives were also administered, succeeded by saline medicines, and a quiet position was enjoined for eleven days, by which time the swelling began somewhat to subside. Still the precise nature of the injury was not satisfactorily evident; but it was thought by Mr. Nunn, of Colchester, and Mr. Travis, of East Bergholt, who had kindly come over to witness it, that there was a luxation. The only difficulty we had in reconciling this notion to ourselves, was the belief in our minds that no author had adduced an instance of this accident, without an alteration in the length of the limb, except it might be Mr. Astley Cooper, in his new publication, which neither of us had yet seen. We accordingly had recourse to a minute examination of the skeleton; when we immediately fancied we could account for the absence of the usual marked signs of displacement of the head of the bone, excepting the inversion of the knee and foot, in this kind of luxation; for we noticed, that if the head of the bone

be luxated sidewise into the ischiatic notch, it will produce scarcely any difference in the length of the limb. Trusting that a little further delay might not be attended with any material disadvantage, but give a chance for the entire subsidence of all the inflammation and swelling, we proposed meeting again as soon as we conveniently could, by which time we might consult Mr. Cooper's book. We accordingly met on Sunday, the 30th of August, which was fifteen days after the accident; and from the complete removal of all swelling, the whole of the femoral bone was satisfactorily traced to its rounded head, which was lodged in the ischiatic notch.

Upon referring to the "Essays," which we had now before us, we had the case delineated and described; and as it was exhibited in a plate, we had only to imitate, in order to accomplish the reduction of the bone. In the presence of two or three other medical gentlemen, who had now joined us, we commenced the operation; and as it would be unnecessary to state every particular, considering the manner in which the position of the patient, and the fixing of the pulleys and towels, are demonstrated by that publication, suffice it for me to remark, that, after ten or twelve minutes of gradual extension, the reduction of the bone was most readily and admirably accomplished.

Preparatory to commencing the operation, we took thirty ounces of blood from the arm *ad deliquium*,

and the patient was sent to the hospital. After a few days he was able to walk about, and the operation was successful. The patient was allowed to move upon crutches, and was shortly afterwards home perfectly well.

The dislocation in the ichiatric notch has been, as far as I know, the only author who has written on the subject (succinctly described), for it has been stated, that the limb was lengthened in this accident, and I need hardly mention the mistakes in practice to which so erroneous an opinion has given rise. One instance, however, of such an error I must here give. A gentleman wrote to me from the country in these words, "I have considered my case of injury to the hip, and I should suppose it a dislocation into the ichiatric notch; but that the limb is shorter, instead of being longer, as authors state it to be." Into this error those authors must have fallen from having examined a pelvis separated from the skeleton, and observed that the ichiatric notch was below the level of the acetabulum, when the pelvis was horizontal, although it is above the acetabulum in the natural oblique position of the pelvis, at least as regards the horizontal axis of the sacro-iliac. It is to be remembered, that there is

no such accident as a dislocation of the hip downwards and backwards.

For the particulars of the following case I am indebted to Mr. Chapman, formerly a dresser at Guy's Hospital.

Case. John Cockburn, a strong muscular man, aged thirty-three, was admitted into Guy's Hospital on the 31st of July, 1819. While carrying a bag of sand, at Hastings, on the 24th of June, he slipped, and dislocated the left hip-joint; and the following is the account he gives of the accident :—the foot on the affected side was plunged suddenly into a hollow in the road, which turned his knee inwards at the same time that his body fell with violence forwards. On the day on which the accident happened, two attempts were made to reduce the dislocation by pulleys, but without success ; and, on the 27th of June, a third, but equally unsuccessful, trial was made, although continued for nearly an hour. He was directed to Guy's Hospital by Mr. Stewart, surgeon, at Hastings.

It was found upon examination, after he had been admitted, that the thigh was dislocated backwards into the ischiatic notch, the limb was a little shortened, the knee and foot were turned inwards, and the toe rested on the ball of the great toe of the other foot ; the head of the bone could not be felt ; the trochanter major was opposite the acetabulum, the rim of which could be distinctly perceived. When the

body was fixed, the thigh could be bent so as nearly to touch the abdomen. The patient was carried into the operating theatre soon after his admission; and when two pounds of blood had been taken from him, and he had been nauseated by two grains of tartarized antimony, gradually administered, extension was made with the pulleys in a right line with the body, and the upper part of the thigh was raised while the knee was depressed; the extension was continued for at least an hour and a half, during which time he took two grains more of tartarized antimony, by which he was thoroughly nauseated; the attempts, however, at reduction did not succeed.

On the 3rd of August, the tenth day from the accident, Mr. Astley Cooper succeeded in reducing it in the following manner:—he ordered so much blood to be taken from the arm as to produce a feeling of faintness. A table was placed in the centre, between two staples, upon which the patient was laid on his right side; a girt was passed between the scrotum and the thigh, and carried over the pelvis to the staple behind him; and thus the pelvis was, as far as possible, fixed; a wetted roller was carried around the lower part of the thigh, just above the knee, and a leathern strap buckled on it, to which, and to a staple before the limb, the pulleys were fixed. The body was bent at right angles with the thigh, which crossed the upper part of the other thigh: then the extension with the

pulleys was begun, and gradually increased until it became as great as the patient could bear. An assistant was then directed to get upon the table, and to carry a strong band under the upper part of the thigh, by which he lifted it from the pelvis, so as to give an opportunity for the head of the bone to be turned into its socket. Mr. South, who held the leg, was directed to rotate the limb inwards, and the bone, in thirteen minutes, was heard to snap suddenly and violently into its socket.

I believe that, in this case, I should not have succeeded in reducing the limb, but from attention to two circumstances: first, I observed that the pelvis advanced within the strap which was employed to confine it, so that the thigh did not remain at right angles; and I was obliged to bend the body forwards to preserve the right angle during extension; and, secondly, the extension might have been continued for any length of time, yet the limb would never have been reduced, but by the rotation of the head of the thigh-bone towards the acetabulum.

The following case was communicated by Mr. Worts, dresser to Mr. Chandler, surgeon to St. Thomas's Hospital.

Case. James Hodgson, a sailor, aged thirty-eight years, a strong muscular man, was admitted into St. Thomas's Hospital, on Tuesday, the 18th of February, for an injury which he had received in his left hip; his foot was raised from the ground

upon a chest of fruit, when another fell upon his thigh, striking the knee inwards ; he fell, and being taken up extremely hurt, he was directly brought to the hospital. Upon examination, I conceived that it was a dislocation of the hip-joint, and that the head of the bone was thrown into the ischiatic notch. Some difference of opinion, however, arose upon the subject ; and as considerable tension existed, which prevented the head of the bone from being distinctly felt, I ordered an evaporating lotion, and left the case for further investigation. Upon further consideration, my opinion was strengthened concerning the nature of the injury, as it was clearly pointed out by the diminished length of the leg, which was three quarters of an inch shorter than the other, and by the inversion of the foot ; although there was in this case more power of flexion in the limb than might have been expected, but no rotation outwards. Mr. Chandler saw the case on Saturday the 12th, and, on account of the tension, he ordered some leeches to be applied to the part, and the lotion to be continued. Mr. Cline saw it this afternoon, and thought it a dislocation in the ischiatic notch.

Monday morning, the 14th. The swelling had greatly subsided, and I thought I could now feel the head of the bone on rotation of the limb. Mr. Chandler saw the case again this morning, and expressed a wish for Mr. A. Cooper to see it. Mr. Cooper, at my request, very kindly saw it in the

evening, and immediately declared it to be a dislocation into the ischiatic notch ; and upon his rotating the thigh, I could much more distinctly than before feel the head of the bone in the ischiatic notch. Mr. Cooper recommended me to take away blood, which I did the next morning, to the amount of sixteen ounces ; this considerably relieved the pain the man had previously suffered, and the tension continued to abate till the Saturday morning following, when Mr. Chandler again saw him, and he thought it had sufficiently subsided to justify the attempt at reduction. I accordingly made preparations in the following manner :—at about half-past two o'clock, I took sixteen ounces of blood from the patient, which produced no sensible effect ; at ten minutes past three, I took about twenty-seven ounces more, and while the blood was flowing gave him a grain of emetic tartar ; this I repeated till he had taken five grains at intervals of a few minutes ; and as he was becoming faint, he was taken into the theatre. I applied the bandages and pulleys to the pelvis and to the knee, bringing the thigh over the other ; we kept up the extension about ten or twelve minutes before we used the strap to raise the head of the bone, and until I thought it had made some progress towards the acetabulum. We then continued the extension, gradually increasing it, at the same time endeavouring to raise the head of the bone and turning the knee outwards, for about fifteen minutes. I had now lost the head of

the bone, but still; as it had not made the usual noise in its reduction, I thought that it would be wrong to remove the pulleys, as the action of the muscles, if the bone had not been reduced, would have again drawn it up, in which opinion Mr. Martin, who assisted me, concurred. The man was now very faint, the extension was therefore continued for about twenty-five minutes longer, when the strap at the knee getting rather loose, we removed the pulleys, upon which it was found that the thigh could now be moved in any direction, and that its position was perfectly natural. The bone was replaced, but at what time it had gained its situation no one could judge, neither could the man describe any feeling that could have indicated it; he was carried to bed in a very faint state.

Mr. Worts naturally expresses surprise that the bone was reduced without its entering the acetabulum with the usual *noise*; but when the muscles have been some time contracted, and when the patient is rendered faint by bleeding, and by the nausea of tartarized antimony, they do not act with the same violence as in the first few hours after the accident.

SECTION IV.

OF THE DISLOCATION ON THE PUBES.

Early detected. This is more readily detected than any other of the dislocations of the thigh.

It generally happens by the foot slipping unexpectedly into some hollow, whilst a person is walking, the body being at the time bent backwards, so that the head of the os femoris escapes forwards.

A gentleman informed me, that this dislocation occurred to him, whilst walking across a paved passage in the dark ; he did not know that one of the stones had been taken up, his foot suddenly sunk into the hollow, and he fell backwards. On examination, the thigh bone was found dislocated on the os pubis.

Signs of. The following signs usually indicate this displacement ; the injured limb is an inch shorter than the sound one ; the knee and foot are turned outwards ; and cannot be rotated inwards ; but there is slight flexion forwards and outwards. But what renders this accident so evident, is the readiness with which the head of the bone can be felt a little above the level of Poupart's ligament, upon the pubes, on the outer side of the femoral artery and vein, where it forms a round hard swelling, which moves when the thigh is bent.

Mistaken. Although so easy to distinguish, yet I have known three cases in which the injury has been overlooked, until too late to afford relief ; this could only have arisen from great carelessness, or excessive ignorance.

Dissection of. A preparation from one of these neglected cases, which I had an opportunity of dissecting, is preserved in the museum of St. Thomas's Hos-

pital. It presents the following appearances :—The acetabulum is in part filled by a new deposit of bone, and is in part occupied by the trochanter major, but both are very much altered. The capsular ligament is very extensively lacerated, and the ligamentum teres entirely divided. The head of the bone is placed on the pubes under Poupart's ligament, which has been thrust up by it ; the iliacus internus and psoas magnus muscles, are stretched over the neck of the bone, and upon them is the anterior crural nerve. Both the head and neck of the bone are flattened, and the latter rests in a new articular cavity formed for it upon the pubes, above the level of which the head of the femur is situated. The edges of the new acetabulum project upon each side of the neck of the bone, so as to confine it laterally, whilst Poupart's ligament confines it upon the fore part. The femoral artery and vein pass close to the inner side of this cavity, for the cervix of the femur.

This injury might be mistaken for a fracture of the neck of the bone, but only through great carelessness and inattention.

Reduction of. The reduction of the dislocation may be accomplished in the following way :—Place the patient upon a table on his sound side ; then pass a girt between the pudendum and the upper and inner part of the injured limb, and fix this to a staple rather before the line of the patient's body. The wetted roller, strap, buckles, and pulleys, should then be placed

above the knee, as before described for other displace-
ments. The extension is to be made in a line behind
the axis of the body, the thigh bone being drawn
backwards. The application of the towel at the up-
per part of the thigh, and lifting the head of the bone
by it, over the edge of the acetabulum, is also neces-
sary in reducing this form of displacement.

The following case, which will illustrate the mode
of reduction, occurred under the care of Mr. Tyrrell,
at St. Thomas's Hospital.

Cass. Charles Pugh, aged fifty-five, was ad-
mitted into St. Thomas's Hospital on the 23d of Janu-
ary, 1823, with a dislocation of the right thigh, which
had been produced by a blow upon the back part of
the thigh, from a cart wheel, at the time he was mak-
ing water at the corner of a street, and unprepared
to resist the violence.

The head of the bone could be distinctly felt below
Poupart's ligament, immediately to the outer side of
the femoral vessels. The foot and knee were turned
outwards, with very little alteration in the length of
the limb. The thigh was not flexed towards the ab-
domen, and was nearly immovable, admitting only of
slight abduction and adduction, also a little rotation
outwards, but not at all inwards.

It was speedily reduced by the following means :—
The patient was placed on his left side, a broad band
was placed between his thighs, and being tied over
the crista of the ilium on the right side, was made



PLATE III.

**FIG. 1. Dislocation of the os femoris upon the pubes,
or forwards and upwards.**

- a.* Ilium.
- b.* Pubis.
- c.* Ischium.
- d.* Femur.
- e.* Trochanter major.
- f.* Head and neck of the femur, situated on the junction of the pubis and ilium.
- g.* The new cup formed for the neck of the os femoris.
- h.* Smooth surface on the pubis, for the femoral artery and vein to rest upon, on the inner side of the new acetabulum.

Fig. 2. Another view of the same preparation, with the femur removed, for the purpose of showing the new acetabulum.

- a.* Ilium.
- b.* Pubis.
- c.* Ischiun.
- d.* The original acetabulum, which was occupied by the trochanter major.
- e.f.* The new acetabulum, formed by ossific inflammation on the pubis and ilium.

fast to a ring in the wall. A wet roller having been put on above the right knee, a bandage was buckled over it, and its straps attached to the hooks of the pulleys, by which a gradual extension was made, drawing the thigh a little backwards and downwards. When this extension had been kept up a short time, another bandage was applied round the upper part of the thigh, close to the perineum, by means of which the head of the bone was raised, and in the course of a few minutes the reduction was easily accomplished. The patient had not been bled nor taken any medicine ; he suffered but little after the reduction, and was able to walk without pain or inconvenience five or six days afterwards.

SECTION V.

DISLOCATION DOWNWARDS AND BACKWARDS.

I have already mentioned, that I have seen no instance of a *dislocation downwards and backwards*; and when I state, that I have been an attentive observer of the practice of our hospitals for thirty years, was also for many years in the habit of daily seeing the poor of London at my house early in the morning, and have had a considerable share of private practice, I may be allowed to observe, that if such a case does ever occur, it must be extremely rare. I cannot help thinking, also, that some anato-

mical error must have given rise to this opinion, as, in the dislocation downwards and backwards, the head of the bone is described as being received still into the ischiatic notch ; but this notch is, in the natural position of the pelvis, above the level of the line drawn through the middle of the acetabulum ; and hence it is, that the leg becomes, not shorter, but longer, when the bone is dislocated into the ischiatic notch.

" A dislocation *downwards* and *backwards*, in which the head of the thigh bone is absolutely thrown behind the tuberosity of the ischium, was lately seen by Mr. Keate ; the patient being a gentleman whose horse fell with him into a ditch. It appears the animal lay upon him, for five or ten minutes, during which he continued struggling to liberate himself from his painful situation as well as he could. From the particulars, it appears that the original dislocation was upon the obturator foramen, but by a secondary displacement, which occurred during the patient's struggles, the head of the bone was thrown behind the tuberosity of the ischium, the very situation from which Sir Astley Cooper considers that the reduction would have been impracticable. However, in this case, the reduction was attended with no very great difficulty. The bone was first replaced upon the obturator foramen, and afterwards, by pursuing the plans proper for reduction of the dislocation on the obturator foramen, the head of the bone was replaced.

In this instance there was abduction of the limb, and the head of the bone could be plainly felt behind the tuberosity of the ischium ; the toes were also turned considerably outwards. If there be no mistake in the account, the case proves, in the first place, the possibility of such a dislocation ; and secondly, so far from its being irremediable, that there is no great difficulty in its reduction. We also find an enumeration of the symptoms, namely, a lengthening and an abduction of the limb, eversion of the toes, and the being able to feel the head of the bone in its unnatural situation." (S. Cooper's First Lines of Surgery, Sixth Edition.)

SECTION VI.

FREQUENCY OF THE DIFFERENT DISLOCATIONS.

From what I have observed respecting the comparative frequency of the dislocation of the thigh, I should think the proportion in twenty cases about as follows :—twelve on the dorsum ilii ; five in the ischiatic notch ; two in the foramen ovale ; and one on the pubes.

Formerly overlooked. Considering the frequent occurrence of these dislocations, it is extraordinary that they should have escaped the observations of former surgeons ; it can only be accounted for by the difficulties which existed in the pursuit of morbid anatomy. I was informed by Mr. Cline, that Mr. Sharpe, a surgeon of

Guy's Hospital, possessing considerable eminence, and author of a "Treatise on Surgery," did not believe that these displacements ever took place.

Now readily recognised. There is great pleasure in contrasting the present state of professional information with that which existed fifty years ago. Our provincial surgeons now readily detect these injuries, and generally succeed in reducing them. Let us never, however, forget that it is to the knowledge of anatomy, and more especially, of morbid anatomy, that we are indebted for this superiority ; and therefore we should never neglect or lose an opportunity of pursuing our investigation on these points, if we wish to increase our reputations as surgeons, and practise our profession with credit.

SECTION VII.

INJURIES LIABLE TO BE MISTAKEN FOR DISLOCATIONS OF THE HIP.

Fractures of the os innominatum. Fractures of the bones of the pelvis are very liable to be mistaken for dislocations ; as any extension, in such cases, adds extremely to the patient's sufferings, and would be liable to produce fatal consequences, even if there existed previously a probability of recovery ; it is necessary to explain in what manner they may be distinguished.

In fractures of the *os innominatum*, through the acetabulum, the head of the bone is drawn upwards,

and somewhat forwards, so that the leg is shortened, and the knee and foot are turned *inwards*: such a case may be readily mistaken for dislocation into the ischiatic notch. If the sacro-iliac synchondrosis be ruptured, there is still a slight shortening of the limb; but, in this case, the knee and foot are turned *outwards*.

Such accidents are to be distinguished from dislocation of the hip, by a perceptible crepitus on the motion of the thigh, if the hand be placed upon the crista of the ilium; and they are attended with more motion than occurs in dislocation.

Fractures of the neck of the thigh bone. There are three species of fracture of the neck of the thigh bone, which are frequently, not only confounded with each other, but also with dislocations of the hip.

These accidents are more frequent than dislocations of the thigh bone; for whilst we receive into our Hospitals of Guy's and St. Thomas's (containing about nine hundred persons) not more, upon an average, than two such in a year, our wards are seldom without an example of fracture of the upper part of the thigh bone.

[As I do not intend to enter into a minute description of the nature of these accidents just now, I shall refer the reader to a future part of the work for any further description of the diagnosis between fractures of the neck of the thigh bone and dislocations. Ed.]

CHAPTER II.

DISLOCATIONS OF THE KNEE.

^{Structure of} joint. The frequent and great violence to which this joint is exposed, also the form of the articulation, the cavities on the head of the tibia being very shallow, would render it extremely liable to displacement, were it not for the extent of articulating surface, and the existence of numerous strong ligaments which connect the os femoris, the tibia, and the patella.

^{Structure of} the knee. The depressions upon the head of the tibia are increased by the addition of the *semi-lunar* cartilages, which rest upon the bone; they receive the condyles of the os femoris, and are attached by ligaments to the edge of the tibia.

Bone. The fore part of the joint is defended by the patella, which has two unequal articular surfaces to play upon the condyles of the os femoris. The head of the fibula forms no part of the knee-joint, but is attached to the tibia from one-half to three-fourths of an inch below its head.

Ligaments. The junction of the os femoris, tibia, and patella, is produced by means of a capsular ligament, which proceeds from the os femoris to the

head of the tibia, and is attached to the edge of the patella, where it divides into two portions, forms wings to that bone, and takes the name of the alar ligament. On its outer side the capsular ligament is covered, and greatly strengthened, by tendinous expansions which are derived from the vasti muscles, and which proceed to the head of the tibia. Internally the ligament has a synovial surface, which is folded within the cavities at the extremities of the long bones, and is reflected to the edge of the articular cartilages, and, it is believed, forms a covering to those cartilages. Beside the capsular, there are several other peculiar ligaments. 1st. The *ligamentum patellæ*, which is extended from the lower point of the patella to the tubercle of the tibia. 2dly. The *external lateral* or *femoro-fibular* ligament, which passes from the os femoris to the head of the fibula, and which divides into two external lateral ligaments. 3dly. *Internal* lateral or *femoro-tibial* ligament, being attached to the os femoris, and to the head of the tibia. 4thly. The oblique or popliteal ligament, which proceeds from the external condyle of the os femoris obliquely, to be inserted into the head of the tibia. 5thly. The crucial ligaments, which pass from the depression between the condyles of the os femoris behind ; the one to a projection between the articular surfaces of the head of the tibia, and the other to a depression behind that projection, so that these ligaments cross each other from

before backwards. The patella has a muscular connexion with the os femoris by the insertion of the rectus, vasti, and crureus. By the ligamentum patellæ it is united with the tibia, and laterally it is joined to the capsular and alar ligaments. This ligamentous junction of the three bones is very firm, but it allows of free flexion and extension, with some degree of rotatory motion when the knee is bent; but although great strength is evident in the construction of this joint, still excessive violence and extreme relaxation will occasionally produce its dislocation.

Dislocations do, however, sometimes occur from excessive violence, or from great relaxation of the connecting ligaments.

SECTION I.

DISLOCATION OF THE PATELLA.

Three forms The patella may be dislocated in three directions ;—viz. outwards, inwards, and upwards.

a. External dislocation of the patella.

The external displacement is the most common ; in which case the patella is thrown upon the outer condyle of the os femoris, where it occasions a great projection, which circumstance, and the incapacity of bending the knee joint, sufficiently mark the nature of the injury.

Cause. Persons who have naturally an inclination of the knee inwards, are most liable to this injury, and it is usually produced by a fall at the time that the knee is turned inwards and the foot outwards, so that the action of the muscles, in endeavouring to prevent the fall, draw the patella over the external condyle of the thigh bone.

b. Internal dislocation of the patella:

The displacement of the patella upon the internal condyle, is much less frequent, and generally happens from a fall upon a projecting body, by which the patella is struck upon the outer side, and forced inwards at the time that the foot is turned in the same direction.

Ligament torn. Unless the ligament has been relaxed from previous disease, it will be torn in either of these dislocations.

Treatment The *reduction*, in either case, may be accomplished in the following manner. Place the patient in the recumbent posture, and let the leg be raised, by lifting it at the heel, so that the extensor muscles of the thigh may be relaxed as much as possible; then press down firmly the edge of the patella, furthest from the articulation, by which the opposite edge will be raised over the condyle, when the action of the muscles will quickly restore the bone to its natural situation.

Case. The following plan was adopted by Mr. George Young, in a case of the external dislocation, which he could not succeed in reducing by other means. He placed the ankle of the limb upon his shoulder, which gave him considerable power in extending the knee joint, when grasping the patella with the fingers of his right hand, he pressed the outer edge of the bone with the ball of his left thumb, and thus forced it into its place.

After-treatment After the reduction, the limb must be kept at rest, and the part kept moist with an evaporating lotion ; after three or four days, bandages may be employed. The motions of the joint are soon restored, but a degree of weakness remains for some time.

From relaxation. Very slight causes produce the lateral dislocation, when much relaxation exists. I have been informed by Mr. Hutchinson, a very intelligent surgeon, that he has frequently seen this accident, and that the tendency to it has arisen, in a large majority of cases, from the relaxation produced by excessive indulgence in *onanism*. The reduction is very easily accomplished in the manner already mentioned ; and it is necessary to employ a laced knee-cap with a strap and buckle above and below the patella, to prevent a recurrence of the accident.

Dislocation of the patella edgewise. Mr. Welling, formerly surgeon at Hastings, relates a case, in which the patella was dislo-

cated upon its edge. The nature of the case was obvious enough, as the edge of the bone forced up the integuments to a considerable height between the condyles, on the fore part of the joint. The dislocation was reduced with some difficulty, by pressing the edges of the bone in opposite directions.

c. Dislocation of the patella upwards.

Nature of. In this displacement, the ligamentum patellæ is torn through, and the patella is drawn upwards upon the fore part of the thigh bone.

Signs of. The nature of this injury is extremely well marked, by the elevation of the patella, the freedom of its motion laterally, and the depression above the tubercle of the tibia from laceration of the ligament: the patient cannot support himself upon the limb, as the knee immediately bends when he attempts to do so. The accident gives rise to a considerable degree of inflammation.

Treatment The treatment required for this injury, in the first place, will be to reduce the inflammation, by the application of leeches and evaporating lotions, at the same time that the limb is kept extended, and the body elevated, to relax the muscles, and prevent as much as possible the elevation of the patella; after from four to seven days, a roller should be placed upon the limb, from the toes to the knee, to prevent swelling, and a splint should be fixed behind the knee, to prevent any motion of the joint; a leather

strap should then be buckled around the lower part of the thigh, just above the patella, and to this should be attached another strap, which should pass on each side of the leg, under the foot, by which the circular strap may be drawn down so as to restore the patella as near as possible to its natural position, and thus approximate the lacerated ends of the ligament, to allow of union.

With attention,
union perfect. With great attention, the union will be perfect; passive motion may be carefully employed at the expiration of a month.

Degree of re-
covery. The degree of recovery depends upon the length of the ligamentous union; being perfect when the lacerated extremities are kept in contact during the union, and the powers of the limb being diminished in proportion to their separation.

d. Dislocation downwards.

A dislocation of the patella *downwards* has been mentioned by some surgeons, but I have not seen any injury deserving such a title. Sometimes the tendon of the rectus muscle is torn through, in which case a depression can be felt above the patella, but the bone itself retains its natural situation. The same position of limb and body is necessary in the treatment of this injury, as in the dislocation upwards, and a pad should be applied over the ligamentum patellæ, and confined there by a roller.

SECTION II.

DISLOCATION OF THE TIBIA AT THE
KNEE JOINT.

Four forms of. The superior extremity of the tibia may be displaced in four directions, viz.:—outwards,—inwards,—backwards,—and forwards. Of these, the two latter only are *complete* dislocations, while the two former are *incomplete*, as the articular surfaces of the tibia, and those of the condyles of the os femoris are still partly in contact.

These *lateral* dislocations occur but seldom.

a. Inwards.

When dislocated inwards, the head of the tibia forms a large projection on the inner side of the joint, the internal condyle of the femur rests upon the external semilunar cartilage, and the external condyle projects to the outer side.

Case. The first case of this injury which I recollect seeing, was brought into St. Thomas's Hospital, during my apprenticeship there, when I remember being struck with three circumstances respecting it:—first, the great deformity of the joint—second, the little force necessary to reduce the displacement—third, the slight degree of local or constitutional suffering which followed; the recovery being complete in a few weeks.

b. Outwards.

When displaced outwards, the tibia projects upon the outer part of the joint, the internal condyle upon the inner side, and the external condyle rests upon the internal semilunar cartilage, the deformity produced being as great as in the former case.

Reduction The reduction in either instance may be readily effected by direct extension, and but little diminution of power in the joint follows. I believe that, in both these dislocations, the tibia is rather twisted upon the femur, than forced merely inwards or outwards, so that the condyle of the os femoris is thrown somewhat backwards with respect to the head of the tibia, as well as laterally.

After-treatment When the patient is first allowed to use the limb after an accident of this kind, the joint should be supported by a bandage or a knee-cap, as from the injury to the ligaments, it remains feeble for some time, although the recovery ultimately is nearly perfect.

c. Dislocation of the tibia forwards.

Signs of. When this accident occurs, the following appearances will be presented, when the patient is in the recumbent position. The head of the tibia projects forwards, and the inferior part of the thigh bone is depressed, being thrown a little to one side as well as backwards : the patella is drawn up by the

action of the rectus muscle. The circulation through the popliteal vessels is obstructed by the pressure of the femur posteriorly, so that the arteries below cease to pulsate, and the foot feels numbed from pressure upon the nerves.

Case. A man named Briggs was admitted into Guy's Hospital, in the year 1802, under the care of Mr. Lucas. He had a dislocation of the tibia forwards, in one extremity, which presented the marks I have described, and a compound fracture of the tibia, with a dislocation of the head of the fibula, existed in the opposite limb. The extent of mischief attending the compound fracture, rendered it necessary to amputate that extremity. The dislocation in the other extremity was easily reduced, by extending the leg from above the knee, and by drawing the leg from the thigh, inclining the tibia a little downwards. The patient recovered.

d. Dislocation of the tibia backwards.

Signs or This injury occasions the following marks. A projection of the condyles of the os femoris anteriorly, a depression of the ligamentum patellæ, the head of the tibia is seated behind the condyles, and the limb is shortened, the leg being bent forwards. My friend, Dr. Walshman, sent me the following particulars of a case which was under his care.

Case. Mr. Luland, a very robust and mus-

cular man, had his shoulder and knee dislocated in consequence of being thrown from his cart, in January, 1794. The head of the tibia was completely dislocated backwards, reaching behind the condyles of the femur into the ham; the tendinous connexion of the patella to the rectus muscle was ruptured; the external condyle of the os femoris was very protuberant; the leg was bent forward and shortened, and there was a depression just above the patella. The patient felt most excruciating pain when the limb was moved, but there was not any considerable suffering when it was at rest. It was reduced by the following means:—Two men extended upwards, one from the groin, another from the axilla, whilst two others extended the leg from a little above the ankle, in the opposite direction; and they gradually increased the force of their extension, till the bone was reduced. At the time of extension, Dr. Walshman directed the head of the bone to its natural situation. A roller was afterwards placed over the knee, the limb was laid upon a pillow, and an evaporating lotion was constantly applied. In this state, the patient remained for a fortnight free from pain, when the Doctor gently moved the joint every other day, as far as he could, without creating pain. In about a month, Mr. Luland began to walk on crutches, in ten weeks he was able to sit at the dinner table, and in five months, had perfectly recovered the use of his limb.

Case. Cases of dislocation of the knee-joint are so rare, that every well marked case is worth reciting.—Mr. Toogood, of Bridgewater, has informed me of a case, where the tibia, fibula, and patella were driven up in front of the thigh; and the os femoris occupied the upper part of the calf of the leg, the internal condyle being nearly through the skin. In fact, the appearance of the case was altogether so dreadful, that there appeared little chance of its reduction. It was, however, reduced easily; the limb was placed in splints, and antiphlogistic measures were enforced. The symptoms were mild, there being but little pain or inflammation; and at the end of a month, he was able to walk a distance of four miles. He eventually recovered the use of his limb.

SECTION III.

PARTIAL LUXATION OF THE THIGH BONE FROM THE SEMILUNAR CARTILAGES.

Reason of. The ligaments of the knee-joint sometimes become so much lengthened from extreme relaxation, or from an increased secretion into the joint, as to permit the semilunar cartilages to glide upon the surface of the tibia, when pressure is made by the femur on the edge of the cartilage.

*First described
by Mr. Hey* The nature of the accident was first

accurately described by Mr. Hey, of Leeds, who was so justly celebrated from his high professional attainments; he also suggested an ingenious and scientific mode of treatment, which is generally successful.

Causes of. The displacement is most frequently occasioned by a person, when walking, catching the toe against some projecting body, whilst the foot is everted, pain is immediately felt in the joint, and the limb cannot be straightened. I have known it also produced by the bed clothes, obstructing the motion of the foot, when a person has been turning in bed. The explanation of the accident is as follows:—

Explanation of the accident. The semilunar cartilages, which receive the condyles of the femur, are united to the tibia by ligaments; and when these ligaments become extremely relaxed or elongated, the cartilages are easily pushed from their situation by the condyles, which are thus placed in contact with the head of the tibia, and when an attempt is made to extend the limb, the edges of the semilunar cartilages prevent it.

Reduction. The mode of reduction is, to bend the limb as much as possible, so as to enable the cartilage to slip into its natural position from the pressure of the femur: the cartilage being thus replaced, the limb can be again properly extended, and the condyles are again received upon the cartilage.

I have, however, known this plan to fail in effecting the desired object, as the following case will show.

Case. A lieutenant in the army, who had been repeatedly the subject of this injury, and who had been as often relieved by the means above recommended, had a recurrence of the accident whilst turning in his bed; he came to town, but the former mode of treatment, although repeatedly tried, did not succeed in reducing the dislocation; he afterwards went to Mr. Hey, of Leeds, but without obtaining relief.

After-treatment. A knee-cap, made to lace closely upon the joint, will generally prevent any further displacement; but in some cases, this is not sufficient.

Case Mr. Henry Dobley consulted me, in consequence of his suffering frequently from this accident. This could only be prevented by the addition of straps to the knee-cap, one of which, of considerable strength, passed just below the patella. His mode of reducing it is as follows:—He sits upon the ground, and then bending the thigh inwards and pulling the foot outwards, the subluxation of the os femoris being external, the natural position of the limb becomes restored.

Case. In another case, that of a young lady, also frequently the subject of this dislocation, the accident could only be prevented by a linen bandage, having four rollers attached to it, which were tightly bound above and below the patella.

Effects of. I have seen some cases of this kind, in which a very great alteration has taken place in the

form and size of the joint, in consequence of a chronic inflammation attending them. The following is an account of one :—

Case Lady D. in falling, twisted her thigh-bone inwards, so as to occasion great pain in the knee-joint. On attempting to extend the limb, she could not move the knee-joint ; but, after pressing the thigh outwards, and leg inwards, with some force, she found herself capable of straightening the extremity. For a fortnight after the accident, the joint was extremely weak, and she could hardly bear it to be moved. She then began to stand upon the limb, supporting herself by crutches ; but when she bore much upon the injured limb, it suddenly bent back, and this produced considerable pain and swelling, at the time she felt the condyles slip from the semilunar cartilages upon the head of the tibia. This occurred repeatedly during a period of fifteen months after the accident, and each time greatly retarded her recovery. Three months after this, she had so far improved, as to be able to walk with the aid of a stick only, when, in endeavouring to raise herself from a sofa, her left knee gave way, as if the bone had slipped from its place ; the thigh-bone being at the same time twisted outwards ; this produced great pain and swelling, and she was again unable to stand upright. Her joints were all remarkably flexible, and when a girl, she often experienced a sensation of having dislocated her knees,

but from this she soon recovered. When I saw her, both knees were much enlarged from effusion of synovia into the cavities of the joints, she could not stand without support, and was unable to straighten the limbs. To relieve her, blisters were applied, and for some time kept discharging; after they were allowed to heal, pressure was employed by means of bandages, which were occasionally removed, to allow of friction. She derived most benefit from the internal use of the pilul: hydrarg: submuriat: comp: and the decoct: sarsaparillæ comp: and externally from the friction.

Dissection of these joints. In the dissection of these cases, the ligament is found extremely thickened; small ligamentous and cartilaginous bodies are hanging from it; part of the articular cartilage is absorbed, and part presents a thick projecting edge. After maceration, the edges of the condyles are found to be much increased by deposit of bony matter.

SECTION IV.

COMPOUND DISLOCATIONS OF THE KNEE.

Very rare. This accident is of very rare occurrence; I have only once seen such a case, which required immediate amputation; and I scarcely know any form of injury which would so urgently call for operation.

Case. On the 26th of August, 1819, I was sent for by Mr. Oliver, of Brentford, to see a Mr. Pritt, in consequence of severe injury to the knee, occasioned by a fall from the coach-box of one of the mails. On examining the limb, I found a large aperture in the integuments, on the outer side of the knee-joint, through which the external condyle of the femur projected, so as to be on a level with the edges of the skin. The inferior part of the os femoris was thrown behind, and to the outer side of the head of the tibia, the bone was twisted outwards, so that the internal condyle was situated upon the head of the tibia, whilst the external condyle was turned backwards and outwards. We succeeded in replacing the bones with much difficulty, but as soon as the extension ceased, they returned to the same position as I have above described.

In consequence of the great severity of the injury, the difficulty of the retaining the bones in their natural situation, and the patient being of a very irritable disposition, I immediately proposed, and with his consent, performed the operation of amputation. Great constitutional suffering followed the operation, but under the judicious treatment of Mr. Cline, who visited him during my absence from town, he gradually recovered.

Dissection. On dissecting the limb after the operation, I found great extravasation of blood into the cellular tissue surrounding the joint; the vastus in-

ternus was extensively lacerated, just above its connexion with the patella; the tibia projected forwards, and the patella was situated to the outer side of the knee. On the posterior part, both the heads of the gastrocnemius externus muscle were torn through, and the capsular ligament so completely divided, as to admit both the condyles of the femur through it. Neither the sciatic nerve, the popliteal artery and vein, the lateral, nor the crucial ligaments, were ruptured.

Attempt to save
the limb. Should a case of compound dislocation of the knee occur, in which a very small wound only existed, admitting of ready closure, it would be right to attempt the preservation of the limb.

SECTION V.

DISLOCATIONS OF THE KNEE FROM ULCERATION.

Cause. From the chronic diseases of joints, not only the synovial membrane and articular cartilages suffer from ulceration, but in some cases the capsular, and also the peculiar ligaments become ulcerated, so that the connexion between the bones is in a great measure destroyed, when the muscles which participate in the irritation, contract and gradually displace the bones, producing great distortion of the limb.

This is most frequently seen in the hip-joint; but it is not uncommon to find at the knee the tibia

drawn out of its proper line, with respect to the femur from the same cause.

Extraordinary distortion Case. Occasionally, the distortions thus produced are very remarkable. Mr. Cline amputated a limb in St. Thomas's Hospital, in which the following alteration had taken place from chronic disease in the knee-joint. The leg was placed forwards, at right angles with the thigh, so that, prior to the operation, it projected before the patient when he was standing. On examining the joint, the patella was found ankylosed to the femur, as also the tibia to the fore part of the condyles of the thigh-bone.

Mode of preventing. Much may be done in the early stage of this disease, to prevent deformity, by the application of splints, and the use of internal remedies, as the pulv: ipecacuanhae comp: to diminish general irritability.

SECTION VI.

DISLOCATION OF FIBULA.

"The upper head of the fibula is rarely dislocated by external violence. I have never seen a case thus produced; but we occasionally meet with a case of dislocation of the upper head of the fibula, in consequence of disease, and then it is thrown backwards. This, however, is not a common case. The treatment consists in the employment of such remedies as

are calculated to stop the morbid process going on in the joint, which is generally of a scrofulous nature; we are to blister the part, and when we have stopped the further progress of the disease, we should perhaps employ compression to fix the head of the fibula in its proper place." (*Cooper's First Lines.*)

CHAPTER III.

DISLOCATIONS OF THE ANKLE-JOINT.

SECTION I.

STRUCTURE OF THE JOINT.

The bones. THE bones which enter into the composition of the ankle-joint are the tibia, fibula, and astragalus. The tibia forms an articulating surface at its lower part, which rests upon the astragalus; and there is a projection on the inner side of the lower portion of this bone, which forms the malleolus externus, and this part is articulated with the side of the astragalus. The fibula projects beyond the tibia at the outer ankle, and forms there the malleolus externus, which has also an articulating surface for the astragalus. The astragalus, which is the superior tarsal bone, rises between the malleoli and the lower part of the tibia, and moves upon it principally in flexion and extension of the foot.

Thus nature has strongly protected this part of the body, by the deep socket formed by the two bones of the leg, and by the ball of the astragalus which is received between them.

Capsular ligament. A capsular ligament, secreting synovia on its internal surface, joins the tibia and fibula to the astragalus. A strong ligament unites the tibia to the fibula, without any intervening articular cavity, as the ligament proceeds directly from one surface of bone, and is received into the other.

Peculiar ligaments. The peculiar ligaments joining the tibia and fibula to the tarsus, are—a *deltoid ligament*, which proceeds from the tibia to the astragalus, os calcis, and os naviculare:—and three very strong ligaments, that secure the lower extremity of the fibula; one *anteriorly*, from the malleolus externus to the astragalus, one *inferiorly* to the os calcis, and the third *posteriorly* to the astragalus. It is owing to the strong ligamentous union of the fibula, that it is more frequently fractured than dislocated; even when the tibia is luxated, the fibula is fractured in two of the species of dislocation of the ankle, and generally in all; but when the tibia is thrown outwards, the fibula sometimes escapes fracture.

Strength of the joint. This articulation, therefore, which is formed by the tibia, fibula, and astragalus, with their cartilages, and synovial membrane, is so strongly protected by the form of the joint, and the numerous ligaments connecting these bones, that great violence is necessary to produce a dislocation, and when this does occur, it is generally accompanied with fracture, the ligaments often affording more resistance than the bones.

Three forms. The tibia may be dislocated in three different directions, viz. inwards, forwards, and outwards; a displacement backwards is also said sometimes to take place. Cases have likewise occurred in which the foot has been thrown upwards, the astragalus being received between the tibia and fibula, in consequence of the ligament, which unites these bones, giving way; but this is only a severe form of the internal dislocation.

SECTION II.

SIMPLE DISLOCATION OF THE TIBIA, INWARDS.

Appearances. This is the most common of the dislocations of the ankle. The malleolus internus forms a projection under the skin, on the inner side of the foot, and the integument is so much distended as to appear in a bursting state;—the foot is turned outwards, so that its inner edge rests upon the ground, when the patient is erect;—a depression exists above the outer ankle, but there is otherwise much swelling;—a crepitus can be usually felt about three inches above the external malleolus on moving the foot, which can be done laterally without difficulty, but the motion creates violent pain.

On dissection. The appearances upon examining the seat of injury by dissection, are the following:—the end of the tibia rests upon the inner side of the astragalus; instead of on its upper articular surface.

face; and if the accident has occurred from a person jumping from a considerable height, the lower end of the tibia where it is connected to the fibula by ligament, is broken off, and remains attached to the fibula, which is also fractured from two to three inches above the malleolus, and the end of the superior portion of the fibula is carried down upon the upper surface of the astragalus, occupying the natural situation of the tibia; the inferior portion of the fibula with its malleolus remains in its natural position, and the ligaments connecting it to the tarsal bones are uninjured.

Cause. The most frequent cause of this accident is jumping from a great height, or it is sometimes produced by the foot being caught whilst a person is in the act of running, with the foot turned out, so that the foot is fixed whilst the body is carried forwards.

Reduction. The reduction of this dislocation, which should be effected as soon as possible, may be accomplished in the following manner:—place the patient upon a mattress, properly prepared, on the side which corresponds to the injured limb, and bend the leg at right angles with the thigh, so as to relax the gastrocnemii muscles; then fix the thigh whilst an assistant draws the foot gradually in a line with the leg, and at the same time press the lower extremity of the tibia ~~outwards~~ towards the fibula,

to force it upon the articulatory surface of the astragalus.

Reason of failure. Great violence will often fail in reducing this dislocation, if the limb be kept extended; when, in the same case, the replacement may be very readily effected after the leg has been bent in the mode I have described. The difficulty in the former instance is from the powerful resistance of the gastrocnemii muscles.

Treatment. After the reduction, the limb is still to be kept upon its outer side, being surrounded by a many-tailed bandage, and supported upon a well padded splint which has a foot-piece; a second splint, also furnished with a foot-piece, is to be placed on the opposite side of the limb, or that which is uppermost; and these splints are to be so secured as to prevent eversion of the foot, and to preserve it at right angles with the leg. The bandage is to be moistened with an evaporating lotion. The subsequent inflammation must be kept within bounds by local or general bleeding as necessary, and the secretions must be attended to.

Period of cure. About five or six weeks after the accident, the patient may be allowed to leave his bed, having the joint well supported by the application of straps of plaster around it. After eight weeks, passive motion and friction should be employed to restore the motions of the joint.

Fig. 1



Fig. 2



Fig.



PLATE VI.

FIG. 1. Anterior view of a dislocation of the thigh at the knee-joint outwards

- a.* Muscles of the thigh.
- b.* Patella.
- c.* External condyle of the femur, which had pushed through the ligaments and skin.
- d. e.* Semilunar cartilages.
- f.* Head of the tibia.
- g.* Leg.
- h, h.* Capsular ligament.

Fig. 2. Dislocation of the tibia outwards, at the ankle-joint.

- a.* Tibia.
- b.* Fibula.
- c.* Os calcis.
- d.* Re-united fracture of the tibia at the malleolus internus.
- e.* Fractured extremity of the fibula.
- f.* The tibia, ankylosed to the outer side of the articulatory surface of the astragalus.

EXPLANATION OF PLATE VI.

Fig. 3. Dislocation of the tibia inwards, at the ankle-joint.

- a. The malleolus internus, dislocated on the inner side of the astragalus.
- b. A portion of the tibia split off.
- c. Fracture of the fibula.
- d. Fractured portion of the tibia adhering, by ligament, to the fibula.
- e. Malleolus externus, with the broken portion of tibia adhering to it.
- f. Astragalus thrown outward.

SECTION III.

SIMPLE DISLOCATION OF THE TIBIA, FORWARDS.

Appearances. This accident produces the following appearances:—the foot seems much shortened and fixed, the toes are pointed downwards, and the heel projects. The inferior extremity of the tibia forms a large projection upon the middle and upper part of the tarsus, under the extensor tendons, and a depression exists before the tendon Achillis.

On dissection. When examined by dissection, the tibia is found to rest upon the upper surface of the navicular and internal cuneiform bones, but a small part of its articular surface is still in contact with the articular surface of the astragalus. The fibula is broken, and the superior portion of the bone is carried forwards with the tibia; whilst the malleolus externus, with two or three inches of the lower part of the fibula, remains in its proper situation; the capsular ligament is lacerated extensively on its fore part, and the deltoid ligament is partially torn through.

Causes. The most frequent causes of this injury are, a fall backwards at the time that the foot is confined, or jumping from a carriage in rapid motion, whilst the toes are pointed forwards.

Reduction. To accomplish the reduction, the patient should be placed on his back upon a mattress.

and the thigh being elevated towards the abdomen, the leg is to be bent at right angles with the thigh; the foot is then to be extended in a line a little before the axis of the leg, the thigh being fixed, and the tibia pressed backwards to its natural position.

Treatment. When the reduction has been effected, the many-tailed bandage and padded splints are to be applied as in the former case, and the same means adopted to prevent excess of inflammation. The position of the limb should be upon the heel, with the knee bent, and the foot well supported. After five weeks the patient may be allowed to get up, as the fibula will then be united; and passive motion may be carefully used.

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SECTION IV.

PARTIAL DISLOCATION OF THE TIBIA, FORWARDS.

Nature of. In this accident, the tibia does but half quit the articular surface of the astragalus, resting in part upon the navicular bone, and in part on the astragalus.

Signs of. The signs of the injury are, the pointing of the toes, the elevation of the heel, a great difficulty in placing the foot flat upon the ground, and a considerable loss of power in the movements of the joint. The shortness of the foot, or the projection of the heel, are not very remarkable the fibula is broken.

Case. The first case of this injury which I saw, was in a very stout lady at Stoke Newington, who supposed that she had sprained her ankle by a fall. The toes were pointed, and the motions of the ankle-joint entirely destroyed. I attempted to draw the foot forwards, and to bend the ankle-joint, but I could not succeed. Some years after, I saw this lady walking upon crutches, the toes were still pointed, and she could not place the foot flat upon the ground.

Dissection. I was not, however, perfectly acquainted with the precise nature of the injury she suffered from, until my friend, Mr. Tyrrell, showed me a foot which he had dissected at Guy's Hospital, and which he was so kind as to give me. It presents the following appearances: the articular surface of the lower part of the tibia is divided into two, the anterior part is seated on the navicular bone, the posterior upon the astragalus; these two articular surfaces formed at the lower extremity of the bone have been rendered smooth by friction; the fibula had been fractured.

Reduction. The mode of reducing this partial displacement should be in every respect similar to that recommended for the complete dislocation; the same directions for the after-treatment should also be adopted. As the signs of the injury are not very well marked, great attention will be required in the examination, and the surgeon should not rest satis-

fied until the motions of the joint are in a great measure restored.

SECTION V.

SIMPLE DISLOCATION OF THE TIBIA, OUTWARDS.

This injury is usually attended with much more mischief to the surrounding parts than either of the former, as it is produced by greater violence ; there is more laceration of ligaments, and more contusion of the integument, and greater injury to the bone.

Appearances. The sole of the foot is turned inwards, and its outer edge rests upon the ground, when the patient is standing ; the foot and toes are pointed somewhat downwards, and the external malleolus forms so decided a prominence upon the outer side, by protruding the skin, that the nature of the accident can scarcely be mistaken.

On dissection. Upon dissection, the malleolus internus of the tibia is found obliquely fractured, and separated from the shaft of the bone ; the inferior portion of the shaft of the tibia is thrown forwards and outwards upon the astragalus before the malleolus : the deltoid ligament remains entire. If the fibula is perfect, the three ligaments naturally connecting it to the tarsus are ruptured ; but when the fibula is fractured, which often happens, these ligaments are not injured. The astragalus is sometimes broken, and the capsular ligament is lacerated.

The injury may be occasioned either by a fall or jump from a height, the foot being twisted inwards, or by the passage of a carriage wheel over the articulation.

Reduction. To effect the reduction, place the patient upon his back, elevate the thigh towards the abdomen, and bend the leg at right angles with the thigh; then fix the upper part of the leg and thigh, whilst an assistant extends the foot in a line with the leg, and at the same time press the tibia inwards towards the astragalus.

Treatment. When reduced, apply the many-tailed bandage and padded splints with foot-pieces, as in the former cases; but in addition, place a pad over the fibula, just above the outer malleolus, so that when the limb is laid upon the outer side, which is the best position, the portion of bone above the pad may be raised, and the pressure of the outer malleolus upon the injured integument may be prevented.

A similar mode of after-treatment to that described for the other dislocations, will be proper, but more depletion will usually be required after this injury, as the inflammation is generally more violent. Passive motion should be employed after six weeks from the accident. In the generality of these cases, from ten to twelve weeks elapse before the cure is complete.

CHAPTER IV.

COMPOUND DISLOCATIONS OF THE ANKLE JOINT.

Nature of. THE only difference between these injuries and those already described is, that in these cases the integuments and ligaments are divided, either by the bone, or by the pressure of some uneven and hard body, on which the limb may have been thrown, so as to expose the joint, from which the synovia escapes through the wound:

SECTION I.

LOCAL EFFECTS.

The consequences of these injuries are, however, very different from those occasioned by the simple dislocations; usually the following effects are produced. The synovia at first escapes through the wound, and in a short time after the accident, inflammation commences; this inflammation extends to the ligaments as well as to the extremities of the bones forming the joint, and the secretion from the joint becomes much increased. ~~less~~^{about} five or six days, suppuration commences; the discharge of matter is small, but it soon becomes very profuse.

Under this process of suppuration, the articular cartilages become partially or wholly absorbed, but in general only partially; the ulceration of the cartilage is a very slow process, usually attended with much constitutional suffering, and is often followed by exfoliation of bone. When the cartilages have been removed, granulations arise from the extremities of the bones, and from the ligaments, which inosculation and fill the cavity of the joint. In some cases, adhesive inflammation occurs in the commencement, and the articular surfaces become united without any absorption of the cartilages; this often occurs in part, but I have seen it extend to the whole surfaces.

Ankylosis does not always follow. But neither the adhesive union, nor the inosculation of the granulations, entirely destroy the motions of the joint, if passive motion be employed sufficiently early and carefully; and I have seen, in some cases, the mobility of the articulation restored to nearly its original extent; otherwise, the other joints of the tarsus acquire such an increase of motion, as to render the deficiency in that of the ankle hardly perceptible. When the powers of the joint are completely destroyed, it is by a deposit of cartilage, and a subsequent formation of phosphate of lime, as is usual in the reparation of fracture of bones.

Thus, then, the compound dislocation of the ankle leads to inflammation over a very extensive surface; it produces a ~~very~~ ^{considerable} ~~which~~ ^{which} ~~occasions~~ ^{occasions} much consti-

tutional disturbance ;—it becomes the source of an ulcerative process, more or less extensive, according to the treatment pursued, by which the cartilage is partly or wholly removed, and an irritative fever is supported for a great length of time ; and the ulceration extends over the extremities of the dislocated bones, and leads to greatly augmented constitutional irritation, and protracted disease from exfoliation.

SECTION II.

CONSTITUTIONAL SYMPTOMS.

The various local effects which I have described are accompanied usually with much constitutional suffering. About twenty-four hours, or in two or three days after the receipt of the injury, the patient begins to complain of pain in the head and back, shewing the influence of the accident upon the brain and spinal marrow. Loss of appetite, nausea, and often vomiting, indicate disorder of the stomach ; the tongue is white, yellowish, or brown, according to the degree of irritation ; the bowels generally become inactive, from a paucity of the secretions, not only from their mucous surface, but from the glands connected with them, as the liver, pancreas, &c. ; the secretion of the kidneys is much diminished, and of a deep colour ; the skin becomes ~~very~~ dry, ceasing to pour out the perspirable matter. The action of the heart and arteries is accelerated, and the pulse becomes

ing *hard*, and in severe cases it is often irregular or intermittent. The respiration is hurried in sympathy with the quickened circulation. When the irritation is great, the nervous system becomes further affected, the patient is restless and watchful, and as the severity of the case increases, delirium subsultus tendinum, or tetanus occurs.

Vary in degree. Such are the usual effects of local irritation upon the constitution, but the degree in which they are developed depends upon the irritability of the system, the powers of reparation, and the extent and violence of the injury.

Cause of symptoms. The cause of the severity of the local and constitutional symptoms in these cases appears to be the exposure of the joint, and the great efforts necessary for the reparation of the injury under such circumstances, as the simple dislocations very rarely occasion these distressing effects, but the adhesive process repairs the mischief, without giving rise to either much local or constitutional disturbance. Thus the first principle in the treatment of the compound dislocation is clearly pointed out, viz.: the closure of the wound, and the aiding, by all means in our power, its union, by adhesive inflammation; so as to prevent suppuration in the cavity of the joint.

SECTION III.

TMENT.

The mode

to be adopted in these cases

is as follows, and will apply generally to either form of dislocation.

Local treatment. The first object will be to suppress haemorrhage, if any of consequence exists. Of the two arteries, the anterior and posterior tibial, which are likely to be wounded, the former will be found most frequently injured, the latter generally escaping; but in case of bleeding from either, it will be necessary to apply two ligatures, one above and another below the aperture from which the bleeding occurs. The projecting extremities of the bones are often covered with dirt, having been thrust against the ground; when the next step will be to cleanse them thoroughly from every particle of extraneous matter, otherwise it will afterwards excite suppurative inflammation in the joint. Should the bone be comminuted or shattered, all the detached portions must be carefully removed, and if the wound is not sufficiently large to allow of their being taken out without much difficulty, it should be enlarged with a scalpel, but the incision should be made in such a direction, as will avoid further exposure of the joint. The wound will sometimes require dilatation, if the integuments are nipped into the joint by the projecting bone, as they cannot be in many instances liberated without.

The reduction of the dislocation is to be accomplished by the same means as ~~already~~ described in the simple displacements, and ~~when~~ reduced, the edges of the wound are to be ~~very~~ ~~approxima-~~

by sutures and strips of plaster, over which a piece of lint, dipped in the patient's blood, is to be placed; this, when the blood coagulates, forms, as far as I have seen, the best covering for the wound. The part is to be further supported by the application of separate pieces of linen, in the same way as the many-tailed bandage, but each portion being unconnected with the others, so that any one piece can be removed, and another substituted for it, by tacking the ends of the old and new strips together, before the former is drawn from its situation; in this way the limb is not disturbed by the change. This bandage is to be moistened by an evaporating lotion. The padded splints are lastly to be employed with foot pieces, as recommended in the simple dislocation, but a portion of that one situated on the wounded side of the limb should be cut out, in order to enable the surgeon to dress the wound without removing the splint. The position in which the extremity should be placed is the same as in the simple injury, but must be occasionally varied a little according to the seat and extent of the wound.

Constitutional remedies. The next object will be to prevent or diminish the constitutional suffering likely to ensue; in some cases it will be necessary to take away blood generally, but this should be done with the utmost caution, as ~~greater~~ power is required to support the after process of ~~recovery~~ ^{restitution}, which will fail altogether if the patient ~~is~~ ^{becomes} feeble by the loss of blood or other ~~substances~~. Medicines should also be adminis-

tered with great care, as the frequent change of position which the action on the bowels necessarily occasions, tends very much to interrupt or destroy the adhesive process, which it is our chief object to promote. I am confident that I have seen many cases of compound fracture prove destructive under such circumstances. The bowels should be emptied as soon as possible after the accident, before the adhesive inflammation is set up, after which a mild aperient may be given at intervals.

After-treatment. Should the patient remain free from pain, this mode of treatment should be persevered in until the adhesive process is complete; but should he complain of suffering in the injured joint, the dressings must be cautiously raised, so as to expose a very small part of the wound, to allow of the escape of any matter which may have formed, but not to disturb any adhesions which have taken place. If the suppurative inflammation has commenced, the first dressings may be removed, and the surface of the wound be merely covered with some simple dressing. Should much surrounding inflammation arise, it will be necessary to apply poultices on the wound, and leeches upon the limb, at a little distance from it, and afterwards to continue the use of the evaporating lotion over the inflamed surface not covered by the poultice. When the inflammation is subsided, the use of the poultices should be discontinued, as they relax the vessels too much, ^{and retard} the progress of cure.

Period of recovery. In favourable cases, the wound heals in a few weeks but with little suppuration. In those less favourable, the discharge is very copious, and portions of the extremities of the bones exfoliate, rendering the recovery very tedious. Even in the most favourable instances, the patient cannot venture to use crutches before the expiration of three months, and often not until a much more distant period.

Amputation formerly performed. Formerly, and within my recollection, it was thought expedient for the preservation of life, by many of our best surgeons, to amputate the limb in these cases; but from our experience of late years, such advice would in a great majority of instances be now deemed highly injudicious and cruel.

I shall now relate a few cases, which will further explain the best mode of treatment, and also show the impropriety of recommending amputation indiscriminately in these cases.

Case. In the year 1797, I attended a gentleman with Mr. Battley, who then practised as a surgeon. This gentleman had, in a fit of insanity, jumped from a two pair of stairs window into the street, by which he caused a compound fracture of the ankle joint; he, nevertheless, got up without assistance, and having obtained admission into the house, he ascended the stairs to his bed-room, and having fastened ~~the~~ door, got into bed. The door was forced ~~open~~ he could not unfasten it. When I examined ~~the~~ limb, I found that the tibia

was dislocated inwards, and that the astragalus was broken into many pieces, many of which being detached, I removed. We then reduced the displaced bone, and having approximated the edges of the wound, covered the whole with lint wetted with the patient's blood. The limb was placed on the outer side, with the knee flexed, and an evaporating lotion was freely applied. In three or four days after, considerable inflammation took place, but this was subdued by general and local bleeding, with emollient applications to the wound; extensive suppuration followed, and continued very profuse for nearly two months, when the surface was covered by granulations; at the same time an improvement took place in his mental affection, which became less and less as the wound closed; between four and five months from the accident, the healing process was complete, and the state of his mind natural. At the expiration of nine months he returned to his employment, but could not walk without the aid of a stick for many months.

Case In October, 1817, I was called by Mr. Clarke, a surgeon, residing in Great Turnstile, Lincoln's Inn Fields, to visit Mr. Caruthers, a young gentleman who had a compound dislocation of the ankle joint inwards, occasioned by the overturning of a stage-coach at Kilburn, from which place he had been removed to Lambeth, where he resided. The extremity of the tibia projected ^{at the extent of} between two and three inches.

the integuments on the inner side. The tibia was broken, a small portion of it remaining attached to the joint by the ligaments; the fibula was also fractured badly. I found it necessary to enlarge the aperture in the integuments, before I could replace the dislocated bone. After the reduction, simple dressings were spread over the wound, these were confined by a many-tailed bandage, moistened with an evaporating lotion, and the limb was supported by the padded splints, and placed in a semiflexed position upon a quilted pillow. The patient was bled, and took mild purgatives, with saline medicines. Considerable local and constitutional suffering followed, which greatly exhausted the patient; abscesses formed in the leg, and some exfoliation took place, much retarding the progress of cicatrization. These abscesses were freely opened, and the parts supported by strips of plaster; the limb was kept cool by the use of evaporating lotion, and the strength was supported by giving bark and wine. In the January, 1819, the last exfoliation occurred, after which the wound healed rapidly, and the patient recovered his health. Mr. Caruthers has since obtained very considerable use of the limb, being able, he told me, to walk six or eight miles if necessary.

Case. Mr. Abbott, of Needham Market, Suffolk, sent the piminiolars of the following interesting case, which ~~oc~~ higher under his care.

Mr. Rob^t ~~itme~~, aged seventy, corpulent, in-

temperate, and of a gouty habit, had his ankle dislocated in consequence of being thrown down in a quarrel ; the end of the tibia was forced through the integuments, and protruded about four inches ; the fibula was fractured a few inches above the joint, and the foot was turned outwards. Immediately he got up, and in struggling to stand, he covered the end of the bone with dirt and sand, of which also a considerable quantity got into the joint. He was conveyed home about four miles in a cart, and Mr. Abbott saw him about five hours after the accident, and recommended amputation in consequence of the extent of injury, and the disordered state of the patient's constitution ; but this the patient could not be induced to submit to, therefore the injured parts were carefully and thoroughly cleansed with warm water, the dislocation was reduced, and the edges of the wound were nearly brought into apposition by strips of linen dipped in the *tinctura Benzoini composita*, without sutures or adhesive plaster ; a thin board, hollowed to receive the leg, and with an opening in the situation of the outer ankle, being well padded, was placed under the outer side of the limb, which was enveloped in a folded flannel bandage, from the foot to the knee ; the leg was laid in a flexed position, with the foot a little raised. The patient was bled to $\frac{5}{6}$ ij, and ordered a mild saline ~~active~~ ^{active} every two hours, until the bowels were re^v with milk broth for his food.

The accident happened on the 25th of April, 1802; and he proceeded very favourably until the 27th, when he complained of darting pains in the injured limb, and he was restless, yet his skin and bowels were acting properly. Upon unfolding the flannel, some swelling appeared about the joint, and some gleet discharge escaped from beneath the dressing; the inflammation did not appear much more than necessary, but six leeches were applied at a little distance from the seat of inflammation, which relieved the pain, and the wound was dressed as before. This plan of treatment was continued, and the case proceeded most favourably; on the 2d of May, a small quantity of matter was discharged, but without augmenting the symptoms. After ten weeks, he was moved daily from the bed to a sofa, and about this time the whole of the dressings were taken off for the first time, when the wound was found to be completely cicatrized; previously, only small portions had been elevated at a time, and fresh pieces put on to keep the covering perfect. When exposed, the exterior of the joint presented its usual appearance, excepting a slight enlargement in the situation of the cicatrix; but this was not more than could be expected. At the end of five months, he was allowed to go on crutches, and bear as much weight on the limb as his own feelings admitted to be proper. Being a butcher by business, he afterwards rubbed the limb with

the fat of animals and also

frequently placed his foot and ankle in the warm paunch of an ox. Before the expiration of twelve months, he could walk without the assistance of a stick, and for many years before his death could walk with perfect ease and freedom. He lived to the age of eighty-three.

The following are the particulars of a case sent to me by Mr. Scarr, surgeon at Bishop's Stortford; he also sent the patient for my inspection, after his recovery, so that I had an opportunity of witnessing the happy result of Mr. Scarr's skill.

Case John Plumb, aged 38, had ascended on a ladder, about ten feet from the ground, with a sack of oats upon his shoulders, when the ladder slipped from under him, and he fell to the ground upon his feet, still retaining the load of oats. Mr. Scarr was passing at the time, and immediately attended to the man. When his stocking had been removed, the tibia and fibula were found projecting through the skin at the outer side of the ankle, and the astragalus was exposed through an opening on the inner side; both the wounds were clean, and without much surrounding mischief. Mr. Scarr therefore immediately reduced the displacement, and closed the wounds by the application of adhesive straps, and placed the patient in bed, with the limb flexed, and laid upon the outer ~~side~~. The limb was moistened with a lotion of ~~ac~~ ^{ato} ~~lead~~ ^{lead}. About $\frac{3}{4}$ of blood were taken from the ~~some~~ some saline

medicines administered ; and the antiphlogistic treatment persevered in, with due regard to his constitutional powers ; some abscesses formed, which were opened in the most favourable points, and the patient became gradually convalescent in about six months, without any very urgent symptoms. At the end of twelve months, he was able to resume his laborious occupation as before the accident.

Removing a portion of bone. It has been recommended in the treatment of these cases, to remove with a saw the projecting extremity of the tibia, before the reduction of the dislocation is attempted ; there are some instances in which such a proceeding is absolutely necessary, and many reasons are given for adopting this practice in general.

When necessary. The cases in which it must be necessarily adopted are the following :

First, when the dislocation cannot be otherwise reduced without great violence.

Secondly, when the extremity of the bone is fractured obliquely, so that if reduced it immediately slips from its proper situation, when the extension is discontinued ; but after the removal of the point by the saw, it rests readily upon the astragalus.

Reasons for removal, generally The reasons assigned for adopting this plan in all instances are,

First. That the shortening of the bone relaxes the muscles, and diminishes the tendency to spasmodic contractions, which so frequently occur when much force has been used to replace the bones.

Secondly. That the adhesive process goes on much more readily from the sawn extremity of the bone than from the natural articular surface, consequently the local irritation is less.

Thirdly. That when the suppurative inflammation does occur, it is rendered much less, as there is not the same extent, by nearly one-half, of cartilaginous surface to be removed by ulceration, and thus by the diminution of the ulcerative and suppurative process, the constitutional irritation is much lessened.

Fourthly. It has been remarked, that those cases have usually recovered quickly, in which the extremities of the bones have been broken into many small pieces, and separated so as to render their removal necessary.

Fifthly. I do not recollect any instance of unfavourable termination, when this practice had been pursued; but I have known many unsuccessful in which it had not been adopted.

Objections. The objections made to this treatment are, first, that the limb must be shortened by the removal of the portion of bone, and, secondly, that the joint must afterwards become ankylosed.

Not important. Provided we admit that the danger of the case is lessened, which I believe, by sawing off the extremity of the tibia, the first objection cannot be considered of much weight, more especially as the defect is so easily remedied afterwards, by increasing the thickness of the sole of the boot or shoe. With

regard to the second objection, I do not imagine that ankylosis is at all a necessary consequence, having seen cases in which considerable motion remained after the removal of bone, and recovery of the patient. I know that ankylosis is liable to take place in either mode of treatment, but even then the patient, after a time, walks with very little halt, as the other tarsal joints acquire so much increase of motion.

Treatment adapted to the case. It appears to me, however, that either plan may be adopted, according to the features of the case, and I should not wish it to be supposed that I recommend the one to the entire exclusion of the other.

General principles. When the dislocation can be reduced without much force, and the bones retain their proper situation readily, without the occurrence of spasmodic muscular action ; and if the patient be not very irritable, an attempt should certainly be made to effect a cure, without removing the ends of the bones ; but if the bones be shattered, or fractured obliquely, so that it will not retain its proper position when reduced, the saw should be employed, in the first instance, to smooth the ends of the bones, when the small separate pieces have been taken away, and in the second place, to make a surface to rest upon the astragalus. I would also rather use the saw, than employ great violence to reduce the dislocation otherwise ; likewise, in the cases where the spasmodic contraction

of the muscles renders it extremely difficult to keep the injured joint in its natural position.

I shall now relate some cases, which will afford an opportunity of judging better of the propriety of what I have stated.

Case. Nathaniel Taylor, aged thirteen, was admitted into Guy's Hospital, in consequence of his having a compound fracture of his ankle joint. The injury had been occasioned by a boat falling upon his leg. The end of the tibia and the fractured extremity of the fibula projected through an extensive opening at the outer ankle ; the malleolus externus retained its natural situation and ligamentous connexions. The foot was turned inwards, and hung so loosely, that the sole could be placed against the side of the leg. I tried to reduce the bones to their proper situations, but could not effect it, but by very great force, and as soon as the extension was discontinued, they again slipped from their places. Under these circumstances, those around me urged me to amputate the limb ; but considering my young patient to be otherwise in good health, and not of an irritable habit, I determined to preserve the limb if possible. On a further examination, I discovered that the malleolus externus and inferior part of the fibula connected to it, although in its natural position, was very loose, and I therefore removed it, by dividing the ligaments with a scalpel, and I afterwards sawed off about half an inch of the end of the tibia. *When found*

that I could easily replace the bones, and that they retained their positions without difficulty. Having approximated the edges of the wound, I covered it with lint dipped in the patient's blood, and by strips of adhesive plaster; the limb was placed upon the heel, and supported by padded splints. Scarcely any constitutional suffering occurred, but little suppuration took place, and the wound gradually healed. One abscess formed over the tibia, but did not give rise to any severe symptoms. He was allowed to get up, and to use his crutches after about two months, and at the expiration of four months he could walk very well. There appeared to be some motion at the ankle, but the tarsal joints had evidently acquired much increase of motion.

Case In December, 1818, I was called upon to attend, with Mr. Jones, of Mount Street, a Mr. West, aged forty, who had severely injured his left ankle, by jumping from a one horse chaise, alarmed at the horse's kicking.

When I first saw him, the extremity of the tibia projected through a wound in the integuments, at the inner side of the ankle, and a portion of skin was nipped into the joint by the bone, the foot was turned outwards, but hung loosely. Finding that our patient was of a most irritable constitution, and seeing that great violence must be employed to reduce the bone, and that to effect the reduction it would be
lerably, I con-
xtremity of the

tibia, in order to avoid these evils. I therefore sawed off a portion of the bone, and then effected the reduction without difficulty, nor was there any disposition to further displacement from muscular contraction. The edges of the wound were next secured in contact, by the insertion of a fine suture, and the part was covered with lint wetted with blood, and a many-tailed bandage. The limb was secured by the padded splints, and placed upon the outer side, in a semi-flexed position. The patient was bled to the extent of $\frac{3}{4}$ x, some opium was given him, and the spirit lotion was freely applied to the extremity. On the third day, the foot exhibited slight vesications, and he complained of tension, and some pain, but this soon subsided. About the sixth day, the wound began to discharge a serous fluid, mixed with red particles; poultices were employed; the secretion soon became purulent, and continued to increase until the end of a month, when it gradually subsided. At the end of two months, the patient was allowed to get on to his sofa, as the joint appeared firm; a small wound still, however, existed, from which it was evident some small exfoliation would take place; this did not happen for several months. During the progress of the case, Dr. Pemberton was consulted in consequence of the patient's having an extremely disordered state of stomach; but, notwithstanding, the symptoms produced by the accident were not more severe than those usually occurring in a ~~mon cas~~ compound fracture.

Dr. Rumsey, of Amersham, was so kind as to send me the account of an excellent case of compound dislocation of the ankle, complicated with simple fracture of the thigh bone of the same limb; the following are the particulars:—

Case. Mr. Tolson, aged forty, was thrown from a curricle, on the 21st of June, 1792, and in falling, dislocated his left ankle joint. Dr. Rumsey saw him about two hours after the accident, when he found a large wound at the outer ankle, through which the extremities of the tibia and fibula, with a portion of the astragalus, protruded; for the astragalus had been fractured, and one portion of the bone still remained attached to the tibia and fibula, the foot was turned inwards and upwards, and the skin of the outer side, beneath the wound, was very much confined by the dislocated bones. Dr. Rumsey, deeming further advice necessary, sent for Mr. Pearson, of London, and Mr. Henry Rumsey, his brother, a surgeon at Chesham; and during the absence of the messengers, the patient directed Dr. Rumsey's attention to his thigh, which was then ascertained to be fractured at the superior part. This circumstance being considered by Dr. Rumsey and his brother as a decided obstacle to amputation, they determined on endeavouring to preserve the limb. Finding that they could not replace the bones without excessive force, Dr. Rumsey deter-

separating this portion of bone, it was found to be as near as possible the superior half, the fracture having been horizontal through its centre. After this had been taken away, Dr. Rumsey still found it necessary to divide a portion of the integuments, which had been confined by the dislocated bones, before he could readily effect the reduction. The bones being replaced, some lint dipped in tincture of opium was laid over the wound ; the whole was covered with a poultice made of oatmeal and stale beer, and the leg was secured with padded splints. On Mr. Pearson's arrival, he perfectly approved of the course which had been adopted.

In the night following, the patient became delirious, vomited, and his pulse was full and frequent ; he was bled to $\frac{5}{6}$ x, and ordered to take a common saline draught with antimonial wine and tincture of opium every four hours ; the tartrate of potash and manna were given in sufficient quantity to relieve the bowels. He also experienced considerable pain in the ankle and thigh. On the 24th, these unpleasant symptoms had in a great measure subsided, and a discharge commenced from the wound ; he continued the same plan of treatment, with the omission of the antimony, as his stomach was irritable. He continued doing well until the 28th, when the discharge became thin, and he was much troubled with pain and flatulence in the bowels ; it was therefore considered necessary to alter his diet, and on the 29th. he was allowed a small quantity of animal f^e

beer, and port wine ; the bark was also freely taken in substance and in decoction ; he was much benefited by this change. The discharge soon became very copious, in consequence of which the wound was obliged to be cleansed frequently ; the limb was therefore placed upon the heel, as the dressing could not be effectually accomplished without considerable disturbance whilst it continued on the outer side. After the alteration of position, much more attention was required to prevent further displacement, as the foot had a tendency to incline inwards, causing the end of the fibula to project at the wound ; this was however obviated by placing some small wedges between the foot and the fracture box, on the inner side, and others between the calf of the leg and the box on the outer side. About the 30th, the use of the poultice was discontinued, and the wound was dressed with dry lint, over which a pledget, spread with the cerat : plumbi superacetatis, was placed, and confined by a bandage to keep up moderate pressure. The bark and opium were continued until the beginning of August, and the wound gradually healed with only one check from the confinement of matter, the cicatrization being completed about the middle of September. The union of the thigh bone also went on well, but as the ~~start~~ of the leg prevented the possibility of keeping up sufficient extension, a degree of ~~curv~~ ~~ture~~ was produced by the junction. The pa-
on able to walk about with the aid of a

stick only, and acquired a power of motion in the injured joint nearly equal to that of the sound limb.

Another excellent case occurred, under the care of Mr. Cooper, of Brentford, formerly my dresser, who obliged me by sending the particulars from which the following account is taken.

case. Thomas Smith, aged thirty-six, a painter, dislocated his ankle outwards, by a fall with a ladder, his foot being caught between two of the steps. Mr. Cooper was fortunately passing at the time, and immediately attended to the patient. On examining the limb, he found that the fibula was broken about five inches above the outer malleolus, and the tibia fractured longitudinally three inches from the joint; the small inferior portion remained attached with the inner malleolus. About an inch and a half of the inferior part of the shaft of the tibia, and the broken end of the fibula projected through a wound in the skin, rather anterior to the malleolus externus. Mr. Cooper finding that moderate force was not sufficient to replace the bones, he divided a portion of integument, which was pressed in by the protruding bones, and he also removed, with a metacarpal saw, an inch of the tibia, and a small piece of the fibula, after which the reduction was easily accomplished. The edges of the wound were brought together by two sutures, and

were placed to support the limb, which was placed on the heel, and kept cool by an evaporating lotion. In the evening an opiate was given, and he was ordered some aperient for the next morning. Some slight bleeding occurred during the following night, but not sufficient to require a removal of the dressings, which were not, therefore, disturbed until the fourth day, when they were taken off, and the appearance of the wound was then favourable. On the eighth day, a slough had formed, about five or six inches in circumference; a poultice was therefore applied to the foot, and the evaporating lotion continued to the limb above; he also took port wine and bark to support him under the profuse suppuration which followed. The slough separated on the thirteenth day, exposing a healthy granulatory surface, after which merely simple dressing was applied. In five weeks from the accident, the wound was perfectly healed; and in a little more than two months, the fractured bones had become so firmly united, that the patient was able to sit up. In three months he began the use of crutches, and eventually obtained almost a perfect limb.

This man had suffered frequently from colica pictonum, and had an extremely irritable stomach, he was also naturally of a nervous temperament, therefore but ill calculated to support the consequences of so ~~an~~ an injury. He derived considerable benefit ~~from~~ occasional use of the saline effervescent

mixture, and from the free exhibition of opium at night.

These cases I think quite sufficient to show that, in very many instances, not only the life of the patient may be preserved without the removal of the injured limb, but that the extremity is, afterwards, infinitely more useful than any artificial one could be, and that it may become nearly as perfect as previous to the accident.

SECTION IV.

AMPUTATION SOMETIMES NECESSARY.

There are some circumstances, however, which render the operation of amputation absolutely necessary, and these I shall now briefly point out.

In old persons. First, the advanced age of the patient, when the powers of the constitution are not sufficient to support the extensive suppurative inflammation likely to follow the injury, but which the operation of amputation does not expose the patient to.

For very extensive wound Secondly. A very extensive lacerated wound, with much haemorrhage, will render it imprudent to attempt to preserve the limb.

For extensive fracture Thirdly. Extensive comminution of the tibia or of the tarsal bones, as the astragalus and calcis, will give rise to a necessity for amputation. When only some small portions of bone are broken off, they should be carefully removed, and the ends of the bone be smoothed by

Fourthly. The dislocation of the tibia outwards, as it is generally accompanied with extensive injury to the soft parts, as well as to the bones, will often require the performance of amputation.

^{Wound of a large artery} Fifthly. The division of a large artery with an extensive wound, might render the operation necessary ; but I should not, in all cases, recommend amputation on this account, more especially if the injured vessel was the anterior tibia, as I have known more than one instance of recovery, in which this vessel has been secured, and the limb saved. Division of the posterior tibial artery could hardly take place without injury to the large accompanying nerve, which would increase the necessity for removing the limb.

^{Extensive contusion} Sixthly. Extensive contusion of the surrounding soft parts, likely to occasion the formation of large sloughs, would be a reason for amputating ; this will generally happen when the injury has been occasioned by the passage of the wheels of a heavy laden waggon over the joint ; or from the falling of a very heavy weight upon the limb.

These are the principal circumstances which render an immediate performance of amputation necessary ; but there are others which may make it equally proper at a more distant period from the accident.

^{Mortification.} If mortification ensues, the operation will be required ; it is, however, best in such a case that the extent of the mortification is clearly

defined, before the amputation be performed, although I conceive, that when the mortification results from the division of a blood-vessel, or from other local injury in a healthy constitution, a different practice may be adopted to that which would be proper if the disease arose from constitutional causes. I have known the arm amputated in consequence of mortification produced by a division of the brachial artery at the elbow; the mortification was extending at the time, but the patient did well, the limb being removed above the elbow. In another instance, where death of the foot had occurred in a case of large popliteal aneurism, the limb was amputated above the swelling, whilst the mortification was still proceeding up the leg, and the man recovered.

^{Excessive supp-} Should the suppuration from the joint be greater than the constitution can support, as I have seen it, amputation will be required to save the life of the patient.

^{Large exfolia-} Again, when considerable portions of bone are exfoliating, and keeping up a continued state of irritation, if they cannot be removed without inflicting great injury, the operation of amputation should be performed.

^{Deformity of} ^{limb.} Excessive deformity may result from negligence on the part of the surgeon, during the union of the wound, so as to make the limb worse than useless to the patient, when it will be ~~more~~ ^{less} difficult to remove it.

Fig. 1

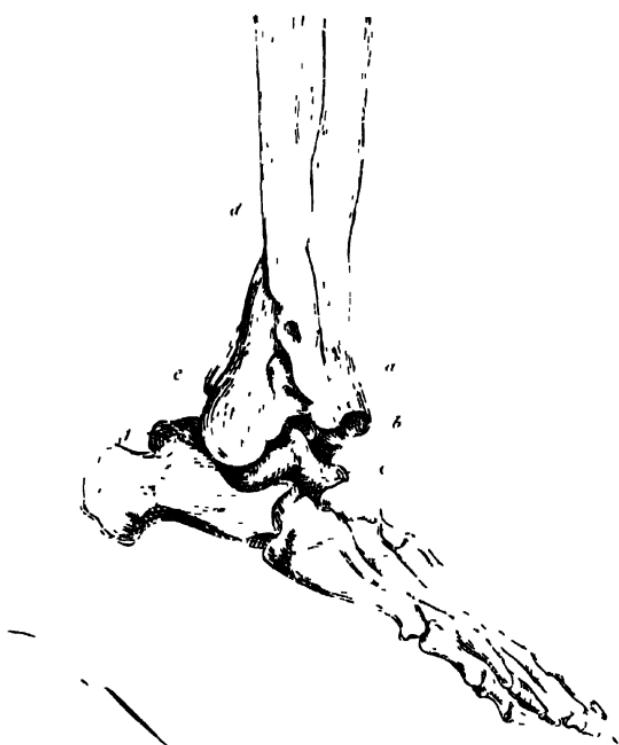


Fig. 2

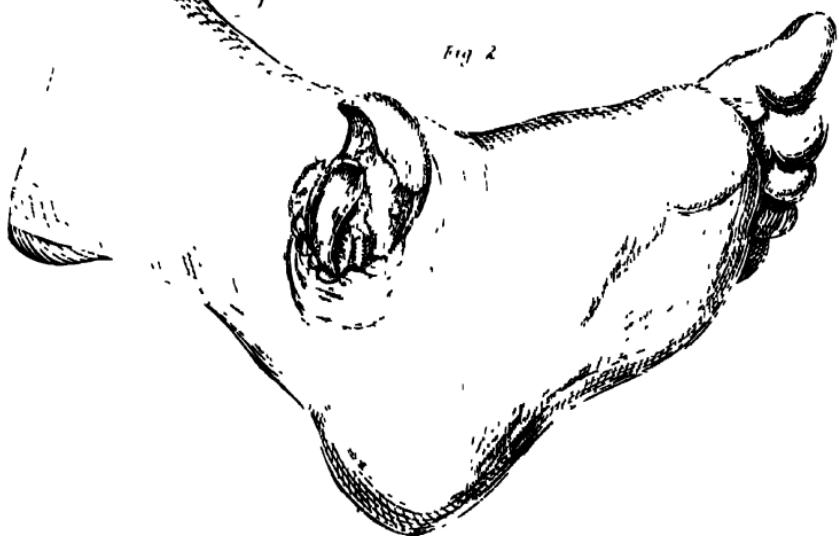


PLATE VII.

FIG. 1. Partial dislocation of the tibia forwards, at the ankle-joint.

- a.* The tibia thrown forwards.
- b.* New articulatory surface of the tibia.
- c.* Astragalus.
- d.* Re-united fracture of the fibula.
- e.* Malleolus externus.
- f.* Astragalus behind the tibia.

Fig. 2. A view of dislocation of the astragalus, as seen in the case of Mr. Downes (Sir A. Cooper's Treatise on Dislocations and Fractures of the Joints, page 156).

Case. Mr. Norman, of Bath, amputated the leg of a man in consequence of such deformity. The patient had suffered from a compound dislocation of his ankle inwards, accompanied with displacement of the astragalus, which was removed. After the union of the wound, it was discovered that the os calcis had been drawn up against the posterior part of the tibia, and had there become firmly united to it, the toes being pointed downwards, rendering the limb useless.

When tetanus occurs. It has been recommended to amputate when tetanus occurs after this injury, but as far as my own experience goes, I believe that the operation only hastens a fatal termination. I have only seen one case of tetanus following compound dislocation of the ankle-joint, which, in spite of every attention on the part of Dr. Relph, who attended the patient with me, destroyed life.

Not advisable. Although I have not witnessed the performance of the operation after the appearance of tetanic symptoms, when the injury has occurred in the ankle, yet I have known it tried in several instances when this formidable affection has been produced from other injuries, and it appeared rather to hasten the progress of the disease than to relieve it.

Case In a case of compound fracture just above the ankle-joint, producing tetanus, the limb was amputated. The tetanic symptoms increased, and speedily proved fatal to the patient.

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case In another instance, when tetanus had followed injury to the finger, amputation was performed, but without alleviating the symptoms, and the man died. I could relate other cases, all showing how unavailing the operation is under these circumstances.

Chronic tetanus I have known a form of tetanus succeeding injuries, in which the symptoms have never been very severe, and which has been termed chronic tetanus; this is sometimes gradually recovered from, although but little be done by medicine, and nothing at all by surgery. The medicine which I have seen most advantage from, has been calomel and opium; and opium should be applied to the wound.

Excessive irritability. There are some persons who are naturally so excessively irritable, that the slightest injuries produce fatal consequences; and in others again, possessing originally good constitutions, this extremely irritable state may be induced by excess of mental exertion, by intemperance, by great indolence, or other causes, so that very trifling accidents will destroy them. Those persons, also, who are much loaded with fat, and especially those who, under such circumstances, are extremely indolent, generally bear important accidents or operations very ill, and frequently perish in spite of the most cautious and attentive treatment.

CHAPTER V.

DISLOCATIONS OF THE BONES OF THE FOOT.

SECTION I.

SIMPLE DISLOCATION OF THE ASTRAGALUS.

FROM the situation of the astragalus, and its very firm ligamentous connexion to the tibia, fibula, calcis, and navicular bone, we could scarcely suppose its displacement possible, and although it is occasionally dislocated, yet the injury very rarely, if ever, occurs, without a fracture of one or more of the surrounding bones.

Reduction difficult. When dislocated, it is extremely difficult to reduce, and if this be not effected, lameness to a considerable extent must be the consequence.

Case I had an opportunity of seeing a patient who was under the care of Mr. James, of Croydon, in consequence of an injury to the tarsal joint. I found that the tibia was fractured obliquely at the inner malleolus, and that the astragalus was dislocated outwards. Every means which Mr. James could suggest had been tried to replace

the bone, but it still continued to project upon the upper and outer part of the foot ; so much force had been employed in making extension, that the integument sloughed in part. Considerable deformity resulted ; the toes were pointed inwards and downwards, and the motions of the joint were in a great measure destroyed. In these cases, the use of pulleys will be required, and the action of the muscles should be lessened by the use of tartarized antimony.

I attended the following interesting case with Mr. West, of Hammersmith, and Mr. Ireland, of Hart Street, Bloomsbury. It is highly interesting and instructive ; and shews most clearly the necessity, that surgeons should be upon their guard, in amputating limbs and in performing operations, as the resources of nature are sufficient, under very formidable circumstances, to effect a restoration.

Case. Mr. Downes fell from his horse on the 24th of July, 1820, and dislocated his astragalus. Mr. West, who first saw him, endeavoured to replace the bone, but could not succeed ; he therefore placed the limb in splints, and kept the part moistened with goulard lotion. The patient was bled largely, and took some anodyne medicine. On the 25th, I visited Mr. Downes with Mr. Ireland and Mr. West, when I found the astragalus displaced forwards and inwards, accompanied with a fracture of the fibula a little above its malleolus. All my attempts to re-

duce it proved ineffectual. The skin over it appeared in a bursting state; so much so, that I felt inclined to divide it and remove the astragalus; but knowing the resources of nature in accommodating parts under injuries, and of restoring the usefulness of the limb, I declined interfering, and the previous treatment was therefore continued. On the 28th, the skin over the bone began to inflame, and notwithstanding the employment of leeches and evaporating lotions, it sloughed on the 16th of August, exposing the astragalus, which gradually became loosened and dislodged. A profuse discharge attended this process, but bark and wine freely given kept up the constitutional powers; the wound was poulticed. On October the 5th, I removed the astragalus, having only to divide some few ligamentous fibres. After this, the wound was dressed with soap plaster, and the patient gradually recovered, being able to walk without the aid of a stick.

SECTION II.

COMPOUND DISLOCATION OF THE ASTRAGALUS.

In compound dislocation of the astragalus, the plan of treatment to be pursued has been already pointed out in the history of the compound dislocations of the ankle joint, from which it is evident, that

moved, and yet the patient recover a very useful limb. If, however, the astragalus should still remain firmly attached, and can be replaced, such treatment should be adopted in preference to taking it away.

Case. Mr. Henry Cline had the following case under his care in St. Thomas's Hospital.

On the 21st of June, 1815, Martin Bentley, aged 30, was admitted into the Hospital, having been severely injured by the falling of some heavy stones upon his legs. An extensive compound fracture of the tibia and fibula existed in the left leg, near the middle, attended with so much mischief to the surrounding soft parts, that Mr. Cline amputated the limb below the knee. On the right side, a dislocation of the astragalus had been produced, occasioning the following appearances :—the os calcis, instead of projecting at its usual place, formed a protuberance on the outer side of the foot, beyond the external malleolus ; and beneath the malleolus was a considerable hollow ; on the inner side, and below the internal malleolus, was a remarkable projection, the toes were turned out, and the foot was inclined in the same direction : the astragalus must have been dislocated inwards, both from the calcis and os naviculare, so that its inferior surface, instead of resting upon the upper part of the os calcis, was placed against its inner side.

The reduction was accomplished by bending the

leg at right angles with the thigh, and extending the foot in a line with the leg, the knee being fixed; at the same time, Mr. Cline placed his knee upon the outer part of the joint, and pressed the foot firmly against it, forcing the bones into their natural positions. The limb was enveloped in a bandage, and placed as much as could be on the outer side, upon a well-padded splint, to which it was secured by tapes. The spirit lotion was applied. On the 1st of July, the man had some sickness and pain, which was relieved by bleeding, otherwise he recovered without any urgent symptoms, and was dismissed from the Hospital on the 26th of August, being able to use his limb tolerably well.

Case. Another case of compound dislocation of the astragalus also occurred under the care of Mr. Henry Cline, for the particulars of which I am indebted to Mr. Green. The accident, as the former, had been produced by the fall of a heavy stone. The foot was turned inwards; the anterior or navicular surface of the astragalus was exposed by an extensive opening; a wound on the inner side exhibited the articular surface of the os calcis for the astragalus. The reduction was made by placing the limb in the same position as for the reduction in the former case; then by extending the foot, and at the same time rotating it outwards.

The patient was a stout middle-aged labouring man, of not very sober habits, and subject to gout.

Extensive erysipelatous inflammation, which terminated in sloughing, and which gave rise to a great deal of constitutional irritation, retarded his recovery, which was, however, ultimately complete.

Mr. Green was likewise kind enough to furnish me with the following particulars of a case which was under his own care in St. Thomas's Hospital.

Case. Thomas Tombs, a bricklayer, aged twenty-three, was brought to the Hospital on the 14th of July, 1820: he had fallen from a scaffold at the height of three stories, and in his fall the foot had been caught between two of the spikes of an iron railing, and in this way he became suspended, with his head downwards. When admitted, a large wound existed beneath the inner malleolus of the left leg, through which protruded the anterior articular surface of the astragalus, which had been separated from the navicular bone. The foot was inclined upwards and outwards; the tendons of the flexor muscles were tightly stretched; the posterior tibial artery had been torn through, and the accompanying nerve partially lacerated. Several attempts were made to replace the dislocated bone, but without success, although the wound was enlarged with a scalpel. As I was at the Hospital, Mr. Green requested me to see the case, and, after a careful examination of the injured limb, I proposed the removal of the astragalus, as much preferable to amputating the limb. Mr. Green therefore carefully separated the liga-

mentous connexion of the astragalus, and took it away ; a ligature was put upon the posterior tibial artery. The natural position of the foot, &c., being then as near as possible restored, the edges of the wound were brought together and supported by straps of adhesive plaster ; the limb was placed upon its outer side, on a well padded splint, having a foot piece ; the evaporating lotion was applied on the limb. For several days after the injury, the patient suffered a good deal from febrile symptoms, and some occasional pain in the ankle ; but when the suppurative process was well established, about the seventh day, all these unpleasant symptoms subsided, and he proceeded very favourably until the end of July, when the formation of an abscess again gave rise to some constitutional derangement, which was relieved as soon as the matter was discharged. A second collection of matter, which occurred about the end of August, again retarded his recovery, and he continued in an indifferent state until the 7th of September, with loss of appetite, and slight hectic ; the leg becoming slightly oedematous, but the discharge from the wound continuing copious. From that period he mended rapidly, but little occurring to retard his recovery, which was complete on the 25th of October. He left the Hospital on the 2nd of November, and has since resumed his business, without any inconvenience.

SECTION III.

DISLOCATION BETWEEN THE TARSAL BONES.

Another form of dislocation of the tarsal bones sometimes occurs from the falling of heavy weights upon the foot; by which the five anterior tarsal bones, together with metatarsus and toes are displaced, the connexions between the astragalus and navicular, and between the calcis and cuboid, being in a great measure destroyed.

Case A man was brought into Guy's Hospital, in consequence of an injury to his foot, upon which a very heavy stone had slipped, whilst working at the Southwark Bridge. The fore part of the foot was turned inwards, whilst the posterior part formed of the astragalus and os calcis remained in the natural state; it presented very much the appearance of a club foot. The reduction was effected by fixing the heel and leg, and extending the anterior part of the foot. In five weeks the man had regained perfect use of the limb.

For the particulars of the following interesting case of compound dislocation, I am indebted to Mr. South. The case was under the care of Mr. Henry Cline, in St. Thomas's Hospital.

Case Thomas Gilmore, aged forty-five, a stout man, and in the habit of drinking freely, was admitted into the Hospital on the 28th of March,

1815, in consequence of an injury to his ankle, which had been occasioned by the falling of a very heavy stone upon his heel. On the fore and external part of the joint was a large wound, reaching from the middle of the inferior extremity of the tibia to the external malleolus, and exposing the anterior articular surface of the astragalus, for the navicular bone, and also that for the os calcis on the outside ; the tuberosity of the os calcis projected outwards, and the toes were directed inwards, towards the other foot. The natural position of the parts was restored by extending the foot and rotating it outwards. The edges of the wound were approximated, and retained in contact by the application of straps of adhesive plaster ; the limb was placed in a fracture box upon the heel, and linen dipped in cold water was placed over the seat of injury, in consequence of some slight bleeding. During the following night he suffered much from spasms in the limb, and slept but little ; but no urgent symptoms presented themselves. On the 30th, severe constitutional irritation had been set up ; he was delirious, his pulse was very quick ; his skin hot and dry, his mouth parched, and he had rigor. Some inflammation appeared about the wound. He continued in this state until the 2nd of April, with some extension of the inflammation up the leg ; taking every six hours the fever mixture, with some antimonial wine. On the 2nd, the severity of the constitu-

tional symptoms had subsided, but he complained of pain in the wound, and the limb exhibited an erysipelatous blush, with some œdema ; a small spot on the leg, which had been bruised, was ulcerated. He proceeded favourably until the 5th, when the constitution became seriously affected, but the symptoms indicated a state of debility, and the ulcer on the leg was in a sloughy state, although the original wound secreted a healthy pus. He was ordered the bark in decoction. Until the 10th, these unpleasant symptoms were present with little alteration, and the superficial inflammation of the limb extended nearly to the groin, and matter appeared to be forming in different parts ; he was allowed a pint of porter, and a grain of opium twice in the day. After this period, the inflammation gradually subsided, and the constitutional suffering became much lessened ; the quantity of porter was increased to two pints daily, and subsequently to three pints, on account of his weakness. Several superficial sloughs formed on the leg, which separated very slowly, not being got rid of until the 15th of May. His appetite and spirits varied considerably, but without any further serious drawback, he gradually recovered, and quitted the Hospital on the 12th of September, being then able to walk easily with the assistance of a stick.

SECTION IV.

DISLOCATION OF THE INTERNAL CUNEIFORM BONE.

I have seen two cases of dislocation of the internal cuneiform bone; the first was in a gentleman, who came to consult me a few weeks after the injury; and the second was in a patient at Guy's Hospital. Both presented the same characters; the bone projected inwards, and also a little upwards, being drawn up by the action of the tibialis anticus muscle.

In the first case, the dislocation was produced by a fall from a height; and in the second, by the fall of a horse, the foot being caught between the horse and the curb stone.

In neither instance was the bone replaced, but the displacement did not occasion any important lameness.

Treatment. I should recommend in the treatment of these accidents,—first, to confine the bone as much as possible in its natural position, by binding a roller around the foot, and to keep the bandage wet with an evaporating lotion, until the inflammation has subsided, and then, to employ a leather strap, which can be buckled around the foot, so as firmly to confine the bone until the ligaments are re-united.

SECTION V.

DISLOCATIONS OF THE TOES.

Scat. of These dislocations are common either between the metacarpal bones and phalanges, or between the phalanges themselves. The same treatment should, in such cases, be adopted, as directed for similar injuries to the fingers.

Case. I had a man under my care in Guy's Hospital, who, in falling from a height, pitched upon the extremities of the toes, and had forced the first phalanges of the smaller toes above the ends of the metatarsal bones, where they projected very much. Several months had elapsed after the receipt of the injury, which rendered all attempts to reduce the bones useless. The patient was afterwards obliged to wear a piece of cork hollowed at the bottom of the inner part of the foot, to prevent the pressure of the metatarsal bones upon the vessels and nerves.

CHAPTER VI.

DISLOCATIONS OF THE LOWER JAW.

SECTION I.

STRUCTURE OF THE ARTICULATION.

The bones that enter into it AN articular cavity is formed behind the root of the zygomatic process of the temporal bone, which receives the condyloid process of the lower jaw at the time when the mouth is shut; and a prominence which is placed before this cavity receives the lower jaw when the teeth are advanced upon those of the upper jaw. Both the cavity and the prominence are covered by articular cartilage. The condyloid process of the lower jaw rests in the cavity with an intervening cartilage whilst the mouth is shut, but it advances upon the root of the zygomatic process when the jaw is much opened, or the lower teeth are advanced.

Inter-articular cartilage. Between the condyloid process and the cartilaginous surfaces, an inter-articular cartilage is placed, having a double concave surface, which al-

lows of the free motion of the jaw, and of its advance upon the zygomatic articular tubercle; whilst the coronoid or anterior process of the jaw is received between the zygomatic arch and the surface of the temporal bone.

Ligaments. A capsular ligament unites the condyloid process to the temporal cavity and to the prominence before it, and joins, in its passage from one bone to the other, the edge of the inter-articular cartilage; whilst a strong internal lateral ligament passes from the margin of the articular cavity to the inner surface of the lower jaw.

Muscles. The jaw is drawn upwards and downwards, backwards and forwards, and transversely. Its elevation is effected by the masseter, the temporal, and the internal pterygoid muscles; its depression by the platysma myoides, digastricus, mylo-hyoideus, genio-hyoideus, and genio-hyoglossus. It is drawn backwards by the temporal muscle, by a part of the masseter; and, when the os hyoides is fixed by the digastricus, the genio-hyoideus, and genio-hyoglossus, it is pulled forwards by a portion of the masseter, and by the combined action of the pterygoidei externi.

The lateral motions of the jaw are principally produced by the contractions of the external pterygoid muscles, which, in alternate actions, pull the jaw from side to side, and give it, with the other muscles, its grinding action, in which these muscles are as-

sisted by the oblique motion forwards, given to the jaw by the pterygoideus internus.

Two forms of dislocation The dislocation of the lower jaw may be either *complete* or *partial*; when complete, both of the condyles are thrown into the space between the zygomatic arch and the surface of the temporal bone; but when partial, one condyle only escapes, whilst the other remains in the articular cavity.

SECTION II.

COMPLETE DISLOCATION OF THE JAW.

Signs of When this accident occurs, the patient appears as if in a continued yawn, the mouth being widely open, without any power on the part of the patient to close it. Some trifling degree of motion often exists, so that the chin can be either elevated or depressed a very little. The chin is advanced, the cheeks are protruded by the coronoid processes, and a hollow is perceived immediately before the meatus auditorius, on account of the absence of the condyloid process from the glenoid cavity. The secretion of the parotid glands is increased, and dribbles over the chin. The pain accompanying this accident is very severe, but I have never seen any dangerous effect produced by it; on the contrary, the jaw becomes more nearly closed by time, and a considerable degree of motion is recovered.

Causes of The displacement may be occasioned—by excessive yawning,—by a blow upon the chin when the mouth is open,—or by endeavouring to force any solid substance into the mouth, too large for the ordinary aperture. Mr. Fox, the dentist, informed me that he had known a dislocation of the jaw take place from spasmodic action of the muscles, when the mouth was widely opened to allow of the extraction of a tooth.

Reduction The reduction of the dislocation should, as in other cases, be effected as speedily as possible, in the mode which the following case will best explain.

Case I was called by Mr. Weston, of Shoreditch, to visit with him a madman at Hoxton, who had had his jaw dislocated in an attempt to force some food into his mouth. Knowing that there would be great risk in employing the means usually recommended, I adopted the following plan:—I had the patient placed upon his back, with a pillow to receive his head, and in that situation he was firmly held; then having procured two forks, I wrapped a handkerchief round their points, and passed the handles into the patient's mouth, one on each side, behind the molares teeth, and whilst they were held in that situation, I forcibly drew the lower jaw towards the upper, by placing my hand under the chin; in this way, the reduction was easily accomplished.

Corks are preferable. I prefer, however, the use of corks, instead of any more solid substance, which is likely to injure the gums; those employed for stopping the common quart bottles are of about the proper size, and should be placed one on each side of the mouth, behind the molares teeth, after which, the chin is to be raised in the manner already described.

Employment of a lever. A long piece of wood is sometimes employed in these cases as a lever, introducing it between the molares, first on one side, and then upon the other, and each time raising the extremity of the wood furthest from the mouth, so as to depress that part of the lower jaw beyond the molar teeth, and with it the condyloid process, when the action of the muscle will draw it into its articular cavity.

Another mode. Another mode which will generally succeed if the dislocation be recent, consists in placing the thumbs, which should be well covered, at the roots of the coronoid processes, and with them forcing that part of the jaw downwards and backwards, and at the same time pressing the chin upwards.

Liability to recur. When once this dislocation has happened, the patient is very liable to a further displacement. After the reduction, a bandage should be applied, having four tails, two at each end, and a hole in the centre to receive the chin; of the tails, two are to be tied over the head, and two behind the occiput; and the patient should not be allowed

to masticate any solid food, until sufficient time has been allowed for the union of the lacerated parts.

SECTION III.

PARTIAL DISLOCATION.

Signs of In this case, the condyloid process on one side only is displaced ; the mouth opened, but not so much as in the complete dislocations ; the chin is directed to the side opposite the injury, and thrown out of the axis of the face.

Cause of This dislocation is usually produced by a blow on one side of the jaw when the mouth is open, and in one case it occurred from vomiting in sea-sickness.

Reduction The reduction may be accomplished either by the cork or the lever of wood.

SECTION IV.

SUBLUXATION OF THE JAW.

Signs of The condyloid process of the lower jaw is, as I have already described the condyles of the femur to be in the knee-joint, sometimes displaced from the inter-articular cartilage of the joint, slipping before its edge, and fixing the jaw, with the mouth slightly open.

Reduced by efforts of the patient. The efforts of the patient alone are usually sufficient to remedy the evil, but I have known it exist a length of time, and afterwards the motion of the jaw and power of closing the mouth return.

Cause of The displacement rarely happens but from extreme relaxation of the ligaments.

Treatment. If called upon to relieve a patient under these circumstances, the force employed should be applied directly downwards, to separate the condyloid process from the temporal bone, and thus allow the cartilage to resume its proper situation.

Frequent in young women. I have most frequently seen this accident in young women, and have found such remedies as will invigorate the constitutional powers, as ammonia and steel, with the shower bath, most serviceable in subduing the tendency to its recurrence.

CHAPTER VII.

DISLOCATION OF THE CLAVICLE.

^{Articulations}
~~strong~~ THE articulations of the clavicle with the sternum, and with the scapula, are so firm as to render displacement of either extremely rare, when compared with the dislocation of some other joints.

In other articulations we find a capsular ligament proceeding from the edges of the articulating surfaces and peculiar ligaments, to give strength to the junction of the bones ; but, in the articulation of the clavicle, like that of the lower jaw and knee, we meet with an inter-articular cartilage, composing a part of the articulating apparatus.

SECTION I.

STRUCTURE OF THE STERNO-CLAVICULAR ARTICULATION. •

^{Bones.} The articulating surfaces, both of the sternum and clavicle, are in part rounded, and in part depressed ; and both are covered by an articular cartilage similar to that of the other joints. A capsular ligament proceeds from the end of the clavicle to the edge of the articulating surfaces of the sternum,

and it is strengthened by short ligaments, which pass directly from one bone to the other.

Interarticular cartilage Within the capsular ligament is situated the inter-articular cartilage, joined at the upper part of the joint to the clavicle, and to the capsular ligament; and, below, to the edge of the articular surface of the sternum and to the capsular ligament, it is inclined under the end of the clavicle with the capsular ligament, so that the clavicle rests upon its surface, and it is also interposed between that bone and the sternum. Of that portion of this cartilage which is inclined to the clavicle, only about one half is smooth, to allow of the motion of that bone, and this is its lower and anterior part. The other portion of it adheres to the articular cartilage of the clavicle, forming a flat rough surface; but on the side towards the sternum the inter-articular cartilage forms a smooth and concave surface, which allows of its free motion on that bone. The inter-articular is placed, not perpendicularly, but obliquely; its upper end is inclined inwards, and its lower end outwards, towards the rib.

Inter-clavicular ligament From the upper point of the clavicle proceeds an inter-clavicular ligament, which adheres to the capsular ligament, and slightly to the sternum; and traversing the upper and back part of the sternum, it is fixed in the extremity of the opposite clavicle, and unites very strongly one clavicle to the other.

**Clavicular
costal ligament**

The clavicle is also joined to the first rib by a clavicular costal ligament, or, as it is called, *rhomboïd ligament*, which proceeds from the inferior edge of the sternal end of the clavicle to the cartilage of the first rib.

**Motions of the
clavicle**

The motion of the clavicle, as well as that of the sternum, forwards and backwards, is performed upon the smooth surface of the inter-articular cartilage, which is applied to the sternum ; whilst the motion of the clavicle, upwards and downwards, is produced upon that portion of the smooth surface of the inter-articular cartilage, which is applied to the clavicle ; and another advantage is derived from this mode of articulation, which is, that it allows of the motion of the bone outwards and backwards to a considerable extent, without occasioning any weakness in the ligament : for in this view it may be considered, that there are two ligaments, one from the clavicle to the cartilage, and one from the cartilage to the sternum, instead of one loose, long ligament from bone to bone.

SECTION II.

DISLOCATIONS OF THE STERNAL EXTREMITY.

Two kinds.

The sternal end of the clavicle may be displaced in two ways ;—first, when thrown anterior to the sternum, or *forwards* ;—second, *backwards*, or behind the sternum.

a. Anteriorly.

Symptoms. In the anterior dislocation, a swelling is readily perceived on the anterior and upper part of the sternum; and if the finger be carried on the surface of the sternum upwards, this projection stops it. On placing the knee between the scapulæ and drawing the shoulders backwards, the swelling disappears; but it reappears when the shoulders are again allowed to advance. If the shoulder be elevated, the swelling descends, and if the shoulder be depressed, the projection ascends towards the neck.

Pain from motion. The patient experiences much difficulty in moving the shoulder, and the attempt creates pain; but when at rest, he suffers but little pain or inconvenience. The point of the injured shoulder is less distant from the central line of the sternum than usual. In very thin persons, the nature of the accident is at first view easily detected, but some difficulty may occur in ascertaining its nature in very fat people.

Cause. This injury is generally occasioned by a fall, either on the point of the shoulder, which drives the clavicle inwards and forwards, or upon the elbow, at the time that it is separated from the side, which produces the same effect.

**Sometimes a partial displace-
ment.** Sometimes this dislocation is only par-
tial, the anterior part of the capsular liga-
ment alone being lacerated;

tion is but slight, but most frequently all the ligaments are torn through, and the bone with the inter-articular cartilage is completely displaced.

Treatment. This dislocation is easily reduced by drawing the shoulders backwards, by which the clavicle is drawn off the sternum, when it falls into its natural situation ; but the shoulders must be kept in this position to prevent a recurrence of the displacement, and the arm must be supported, or its weight will affect the position of the bone.

The application of the clavicle bandage and pads in the axillæ will effect the first object, and the second will be gained by placing the arm in a short sling.

b. Posterior dislocation.

I have never seen, or known of an instance, in which the dislocation backwards has been produced by violence ; yet I conceive that it might happen from a blow on the fore part of the bone, which should tear the capsular and clavicular costal ligament, and allow the bone to slide behind the sternum, occasioning compression of the œsophagus, and rendering deglutition difficult. The trachea would, from its elasticity, elude pressure, and escape to the opposite side of the spine by which this tube enters the thorax.

From deformity. The only case of this form of dislocation that I have known, was occasioned by great de-

formity of the spine, from which the scapula was thrown so much forwards, as not to leave sufficient space for the clavicle between it and the sternum: in consequence of this the clavicle was gradually forced behind the sternum, where it pressed upon the œsophagus, and gave rise to so much inconvenience, as to occasion a necessity for the removal of the extremity; the trachea from its elasticity escaped pressure, being pushed to one side.

This case was under the care of Mr. Davie, surgeon, at Bungay, in Suffolk, from whom I had many of the particulars. He deserved great praise for suggesting the mode of relief; and the skill with which he performed the operation was a proof of the soundness of his professional knowledge.

Case Miss Lofty, of Metfield, in Suffolk, had very great distortion of her spine, by which the scapula was gradually thrown so much forwards, as to displace the sternal extremity of the clavicle, forcing it inwards behind the sternum, so as to press upon the œsophagus, and occasion great difficulty in swallowing.

She had become very much emaciated.

Mr. Davie thinking that he could relieve the sufferings of the patient, and prevent the threatened destruction of life, by removing the sternal extremity of the clavicle, performed the following operation :—

He first made an incision of between two and three inches in extent, over the seat of the dislocation, in a line with the direction of the clavicle. After dividing the soft parts surrounding the bone, he placed a portion of stiff sole leather behind it, whilst he carefully sawed through it, about one inch from its end, with Hey's saw; he then elevated it, and separated it from the inter-clavicular ligament.

The wound afterwards healed quickly, and the patient was again able to swallow without difficulty. She lived six years after the performance of the operation.

SECTION III.

STRUCTURE OF THE SCAPULO-CLAVICULAR ARTICULATION.

The clavicle joins with the scapula about three quarters of an inch behind the extremity of the acromion. The end of the clavicle is slightly convex, and covered by an articular cartilage; the scapula is depressed to receive it, and this surface is also covered by an articular cartilage. Strong ligamentous fibres pass from the clavicle directly to the scapula, and under these a capsular ligament is extended from the edge of the socket of the scapula, to the extremity of the clavicle. The surface of junction is very small, the

end of the clavicle not being larger than the end of the little finger of an adult; and the cavity in the scapula which receives it is very superficial, being not larger than is required to receive upon its surface the end of the clavicle.

Coraco-clavicular ligamenta. But the junction of the two bones is effected by much stronger means, through the medium of the coracoid process of the scapula, which sends forth two ligaments to the clavicle. The first proceeds from the root of the coracoid process, and is fixed in a small tubercle of the clavicle on its under side, at the insertion of the subclavius muscle, and two inches from the extremity of the bone. This ligament has been called the *conoid*, from its form, but may be better named the *internal coraco-clavicular*. The use of this ligament is to bind down the clavicle to the scapula, and to confine the motion of the clavicle forwards and upwards.

The second ligament of this part is called trapezoid; it proceeds from the coracoid process, and passes on the under side of the clavicle to near its scapular end, into which it is fixed; I call it the *external coraco-clavicular*. This ligament is the chief cause which lessens the tendency to dislocation of the scapular extremity of the clavicle, for when its capsular ligament is divided, the scapula cannot be forced under the clavicle without lacerating this ligament, so great is its resistance. It allows of very free motion backwards and

fines its motions forwards. The motions of this extremity of the clavicle are performed by the subclavius muscle, although other muscles also move this bone.

SECTION IV.

DISLOCATION OF THE SCAPULAR EXTREMITY.

Upwards I have never seen any other dislocation of the scapular extremity of the clavicle, than that in which the end of the clavicle is thrown above the acromion process; and I should conceive it very unlikely for any other form to occur; but I do not mean to deny the possibility of a displacement beneath the acromion process of the scapula.

This extremity is more frequently dislocated than the sternal end, and may be detected by the following signs:—

Signs. The shoulder of the injured side appears depressed, and drawn nearer to the sternum, than the sound one. This arises from the scapula having lost the support of the clavicle. On examination, the nature of the injury is readily ascertained, by passing the finger along the spine of the scapula, so as to trace the continuation of the acromion with it; in doing this, the finger is stopped by the extremity of the clavicle, which projects above the acromion, and pain is experienced when this elevation is pressed. The swelling disappears when the shoulders

are drawn backwards, but rises again if they are allowed to come forward. Pressure upon the end of the dislocated bone causes pain ; but when at rest, the patient suffers but little.

Causes. This injury is most frequently occasioned by a fall upon the shoulder, by which the scapula is forced inwards towards the chest.

Treatment. The reduction of the displaced bone in these cases, may be, in most instances, readily accomplished, by placing the knee between the scapula of the patient, and then drawing his shoulders backwards and upwards. After the reduction, a pad or cushion should be placed in each axilla, for the purpose of elevating the scapulæ, keeping them from the side of the thorax, and to defend the soft parts from the bandage, which should next be applied, as in the former case, only it should be broad, and made to press over the seat of injury. The employment of a short sling is likewise of essential importance.

Not perfectly recovered from. It rarely happens that these accidents to the clavicle are perfectly recovered from ; some degree of deformity usually remains, and of this the patient should be informed at the commencement of the treatment, otherwise he may attribute it to the negligence or ignorance of the surgeon ; but this deformity will not interfere with the future motions of the joint.

CHAPTER VIII.

DISLOCATION OF THE OS HUMERI.

SECTION I.

STRUCTURE OF THE SHOULDER-JOINT.

THE shoulder-joint is composed of two portions of bone ; the glenoid cavity of the scapula, and the head of the os humeri.

Glenoid cavity The glenoid cavity is similar in form to a longitudinal section of an egg, with its smaller extremity upwards and inwards, and its larger extremity downwards and outwards ; the cavity is so superficial that the head of the humerus rather rests upon its surface than is received into its hollow ; it is, however, slightly concave, and is covered by an articular cartilage, which is somewhat extended beyond the edge of the bony cavity.

Coracoid process. The coracoid process of the scapula is situated at the upper point of the glenoid cavity, and its basis extends from thence to the notch of the superior costa ; it rises and inclines inwards and forwards, terminating in a point which is situated under

the clavicle, one-third the length of that bone from its junction with the spine of the scapula, and on the inner side of the head of the os humeri, under the pectoral muscle. It covers and protects the joint on its inner side.

Cervix scapulæ. The glenoid cavity is united to the body of the scapula by a narrow neck, which is called the *cervix scapulæ*; and its narrowest part is opposite to the notch of the superior costa of the scapula.

Head of the humerus. The head of the humerus is divided into three parts.—The *first* is an articular surface forming a small part of a sphere, which rests upon the glenoid cavity of the scapula, and is covered with an articular cartilage.—The *second* is a process called the *larger tubercle*, formed for the insertion of three muscles; it is situated on the outer portion of the head of the bone, under the deltoid muscle.—The *third* is a process called the *lesser tubercle*, which is situated on the inner side of the head of the bone towards the axilla, and in the usual position of the arm, nearly in a line with the point of the coracoid process of the scapula.

Bicipital groove. Between these two processes is a groove, which lodges the tendon of the long head of the biceps muscle, and is termed the *bicipital groove*.

Cervix humeri. Immediately below the head of the humerus is situated that portion of " called the *cervix humeri*.

Capsular ligament. The capsular ligament of this joint surrounds the head of the bone, and is attached to the whole circumference of the edge of the glenoid cavity, excepting where the tendon of the biceps muscle passes under it; and at that point it arises from a ligament which proceeds from the coracoid process to the edge of the glenoid cavity. The capsular ligament is also fixed to the two tubercles, and towards the axilla, to the neck of the humerus, just below its articular surface. This ligament is not of an uniform thickness; but at those parts where the joint is not defended from injury by the tendinous insertion of muscles, the capsular ligament itself is thickened, and is capable of sustaining great violence; and this difference is remarkably shown in that part of the ligament which is placed in the axilla, it being of a strong tendinous nature.

Muscles protecting the joint. Four muscles are destined to move the os humeri, and to strengthen the capsular ligament. The first, the supra-spinatus, which arises from the fossa supra-spinata, covers the head of the humerus, blends its tendon with the capsular ligament, and is inserted into the larger tubercle. The second, the infra-spinatus muscle, which proceeds from the fossa infra-spinata, adheres to the back part of the capsular ligament, and is also fixed to the greater tubercle. The third, the teres minor, which arises from the lower edge of the scapula, adheres to the back part of the capsular ligament, and is inserted into the

Fig. 2



Fig. 2



PLATE X.

Sketches, showing the appearances which present themselves in certain dislocations of the shoulder.

FIG. 1. Dislocation of the humerus into the axilla, on the right side.

Fig. 2. Dislocation of the humerus forwards, behind the pectoralis major, and under the clavicle on the left side.

greater tubercle, and into the *cervix humeri*. The fourth is the *subscapularis* muscle, which fills up the venter, or inner concave surface of the scapula; it passes over the inner side of the head of the bone, and is fixed to the smaller tubercle, firmly adhering to the capsular ligament as it passes over its inferior and inner surface. It is between the *subscapularis* muscle, and the *teres minor*, that the capsular ligament is found of great strength, as there are no muscles inserted into that part to protect the joint from injury.

The deltoid muscle, the *coraco-brachialis*, and the *teres major*, which are also muscles of this joint, are not united with the capsular ligament as the other muscles, being only destined for the motion, and not particularly for the protection of the shoulder-joint.

Tendon of the biceps. The tendon of the long head of the biceps protects the upper part of the joint, where it otherwise would be weak, for this tendon is situated between that of the *supra-spinatus* and *subscapularis*; it arises from the upper point of the edge of the glenoid cavity of the scapula, and passes over the head of the bone into the groove between the two tubercles and the portion of the capsular ligament. Reflected towards the articular cartilage of the *os humeri* it adheres to the surface of this tendon, so that the synovia is prevented from escaping.

Cause of its frequent dislocation. The shoulder-joint has a greater extent and variety of motion than any other joint in the body ; and its dislocations are, consequently, more frequent than those of all the other joints in the body collectively ; those of the ankle-joint being next in frequency.

Four directions of its dislocation. The head of the humerus may be displaced from the glenoid cavity of the scapula, in four directions ;—three of the dislocations are complete, and one not perfectly so.

The first is downwards and inwards into the axilla.

The second is forwards, under the pectoral muscle, below the clavicle.

The third is backwards, on the dorsum of the scapula, below the spine.

The fourth is only partial, when the head of the bone rests against the external side of the coracoid process of the scapula.

It has been supposed that a dislocation of the os humeri upwards might occur, but it is obvious that this could only happen under fracture of the acromion. It is an accident which I have never seen.

Frequency of the various dislocations. Of the dislocation in the axilla I have seen a multitude of instances ; of that forwards on the inner side of the coracoid process several, although these are much less frequent than that in the axilla ; of the dislocation backwards I

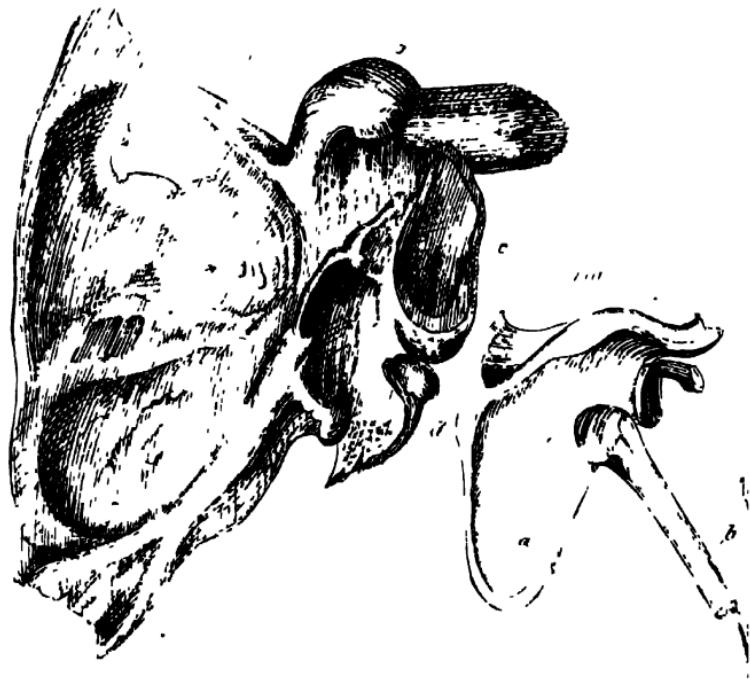
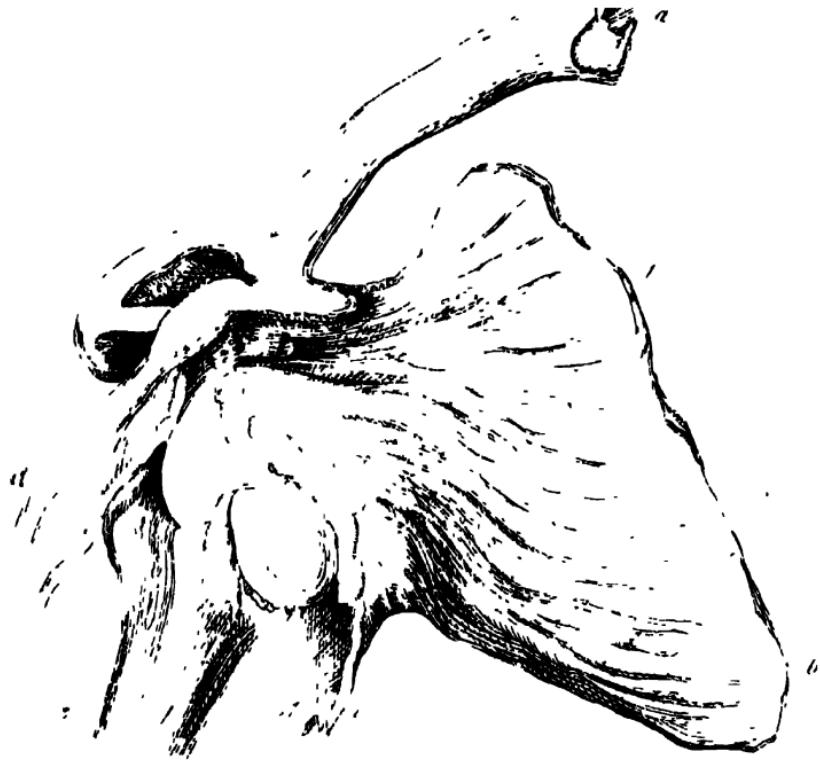


PLATE VIII.

FIG. 1. Dislocation of the humerus into the axilla.

- a.* The clavicle.
- b. b.* The scapula.
- c.* The humerus.
- d.* The biceps muscle.
- e. e.* The subscapularis muscle.
- f.* The capsular ligament, torn ; and the tendon of the subscapularis.
- g.* The head of the humerus, situated on the inner side of the inferior costa of the scapula.

Fig. 2. A view of the new articular cavity formed in dislocation of the humerus into the axilla.

- a.* The scapula.
- b.* The coracoid process of the scapula.
- c.* The glenoid cavity, with the acromion above it.
- d.* The new articular cavity, for the head of the humerus, formed on the inner side of the inferior costa of the scapula.

Fig. 3. Shews the situation of the head of the humerus, when dislocated backwards on the dorsum of the scapula.

EXPLANATION OF PLATE VIII.

- a.* The dorsum scapulæ.
- b.* The humerus.
- c.* The head of the humerus, situated on the dorsum scapulæ.

have seen only two instances during the practice of my profession for thirty-eight years. I do not believe in any change of place after dislocation, when the muscles have once contracted, (except from subsequent violence, which is very uncommon,) beyond that slight change which pressure, by producing absorption, will sometimes occasion. The bone is generally at once thrown into the situation which it afterwards occupies ; so that excepting from circumstances of great violence, the nature and direction of the dislocation are not subsequently changed.

SECTION II.

THE DISLOCATION INTO THE AXILLA.

Signs of. This dislocation may be known by the following signs :—The rotundity of the shoulder is destroyed, and a hollow may be felt below the acromion process of the scapula, in consequence of the head of the humerus being displaced from the glenoid cavity, by which the deltoid muscle loses its support, and is dragged down with the depressed bone. The arm is lengthened, as the superior extremity of the humerus is placed beneath its natural articular surface. The elbow is separated from the side, and cannot be made to touch it, but with difficulty, as the effort presses the head of the bone upon the axillary nerves, occasioning severe pain, and the patient generally

supports the arm with the hand of the sound limb, to prevent the weight from pressing on these nerves. If the elbow be far removed from the side, the head of the os humeri can be easily felt in the axilla, but not so if the arm be allowed to remain nearly close to the side ; raising the limb throws the head of the bone downwards, and to the lower part of the axilla, so that it can be more readily felt.

The motions of the joint are in a great degree destroyed, especially upwards and outwards, and the patient cannot raise his arm by muscular effort ; for this reason, it is usual, when wishing to detect a dislocation, to ask the patient if he can raise his hand to his head. The answer invariably is, that he cannot, if a dislocation exists. The arm cannot be rotated, but a slight degree of motion backwards and forwards still remains.

Motion sometimes considerable. In very old persons, and in those having a relaxed state of muscles, the degree of motion is occasionally but little inferior to that which exists when the bone is in its natural state.

Crepitus. Some time after the accident, a crepitus may be often felt, occasioned by inflammatory effusion, and from the escape of synovia ; but it is never so distinct as that produced from fracture.

There is frequently a numbness of the fingers, from the pressure of the head of the bone upon the axillary nerves.

Thus it will be found, that the principal marks of

the accident are, the loss of the rotundity of the shoulder, the presence of the head of the bone in the axilla, and the destruction of the natural motions of ~~Signs indistinct.~~ the joint. But often these marks are but little apparent in a few hours after the receipt of the injury, from the extent of swelling which occurs, on account of extravasation; they, however, become again distinct when the tumefaction and inflammation have subsided. Under these latter circumstances it is, that the London surgeons are generally consulted, when the nature of the injury cannot be mistaken; whereas, the general practitioner is called upon during the state of tumefaction and inflammation, to form his opinion, and should he then overlook a dislocation, it is our duty, in justice to the general practitioner, to inform the patient that the difficulty of ascertaining the true nature of the accident is very greatly diminished by the cessation of swelling and inflammation.

The readiness with which the injury may be detected, will also differ much in very thin and emaciated persons, or in those loaded with fat, and possessing large and powerful muscles.

Cause. The most common causes of this accident, are falls upon the hand, when the arm is above the horizontal line, or upon the elbow, when the arm is raised from the side; but more especially by a fall upon the shoulder itself, when the muscles are unprepared to resist the violence.

Liability to recur. When the arm has been once displaced, it is much more liable, after the reduction, to be again dislocated, unless great attention be paid to the injured joint; and very slight causes will often produce a recurrence of the injury, which I have known take place merely from the action of lifting up the sash of a window.

Case. When an apprentice at St. Thomas's Hospital, as I was one morning going through the wards, I was called to visit a man who had dislocated his shoulder in the ordinary effort of stretching himself, and rubbing his eyes, when he first awoke.

Proper mode of preventing. To prevent as much as possible this disposition to future dislocation, the limb should be kept perfectly at rest for three weeks after the reduction, during which time, a pad should be fixed on the axilla, and the arm bound to the side, thus the lacerated parts will have time and opportunity to unite, which they cannot well do if the usual motions are permitted.

Dissection. I have had opportunities of dissecting two recent cases of the dislocation downwards, in which I found the following appearances :—

Case. In the first case, the axillary vessels and nerves were forced backwards upon the subscapularis muscle, by the head of the dislocated humerus. The deltoid muscle was drawn down, and the supra and infra spinati muscles were stretched over the glenoid cavity, and inferior edge of the scapula. The head

of the bone was seated between the coraco-brachialis and axillary plexus. The capsular ligament was extensively lacerated on the inner side of the glenoid cavity, as was also the tendon of the subscapularis muscle, where it covers the ligament.

Case. In the second case, violent attempts had been made to reduce the dislocation five weeks after its occurrence, but without success, and the patient died from the effects of the violence used in the extension. The pectoralis major was slightly lacerated, the supra spinatus very much so; the infra spinatus and teres minor were also torn, but not to any great extent; the deltoid and coraco-brachialis had also suffered a little. The capsular ligament had given way between the teres minor and subscapularis tendons, the latter being separated from the lesser tubercle of the humerus.

Muscles affording resistance. In these dissections, I found that the supra spinatus and deltoid muscles were those which afforded the chief resistance to the reduction of this dislocation; therefore, in order to effect the reduction, the best direction in which the arm can be extended, is at a right angle with the body. The biceps should be at the same time relaxed by bending the elbow.

Dissection of an old dislocation. In examining a dislocation which has existed for several years unreduced, the head of the bone is found much altered, being flatteried on that side next the scapula, it is perfectly

covered by a capsular ligament. The glenoid cavity is completely filled by a substance of a ligamentous nature, with some small portions of osseous matter suspended in it, and a new articular surface is formed for the dislocated bone, on the inferior costa of the scapula.

Reduction of the Dislocation in the Axilla.

Modes of reduction differ. The means employed for the reduction of the head of the humerus when dislocated downwards into the axilla, must differ according to the circumstances attending the accident; but in all recent cases, I generally attempt the reduction by the heel in the axilla, which may be done in the following manner:—

By the heel in the axilla. The patient should be placed on a sofa, or table, near the edge, in a recumbent posture, and a wetted roller should be bound round the arm, just above the elbow, over which a handkerchief or towel should be fastened; the elbow being then separated from the side, the surgeon places the heel of one foot in the axilla, and rests the other upon the ground, as he sits by the patient's side. The heel should be placed far enough back to receive the inferior edge of the scapula, and prevent its descent at the time that the arm is extended. The extension is to be made from the handkerchief or towel, and continued steadily for five minutes, in which time usually the bone slips into its

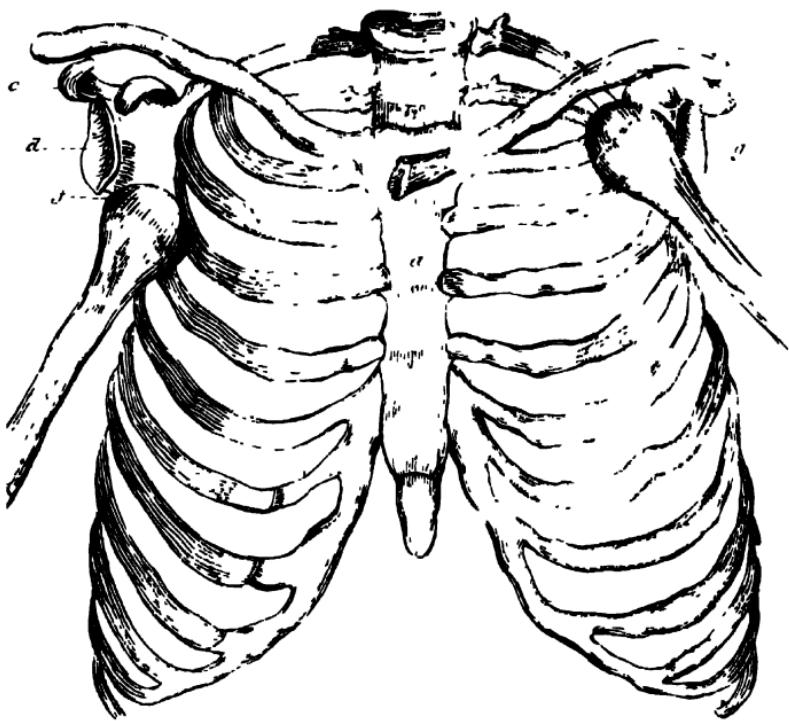


Fig. 2

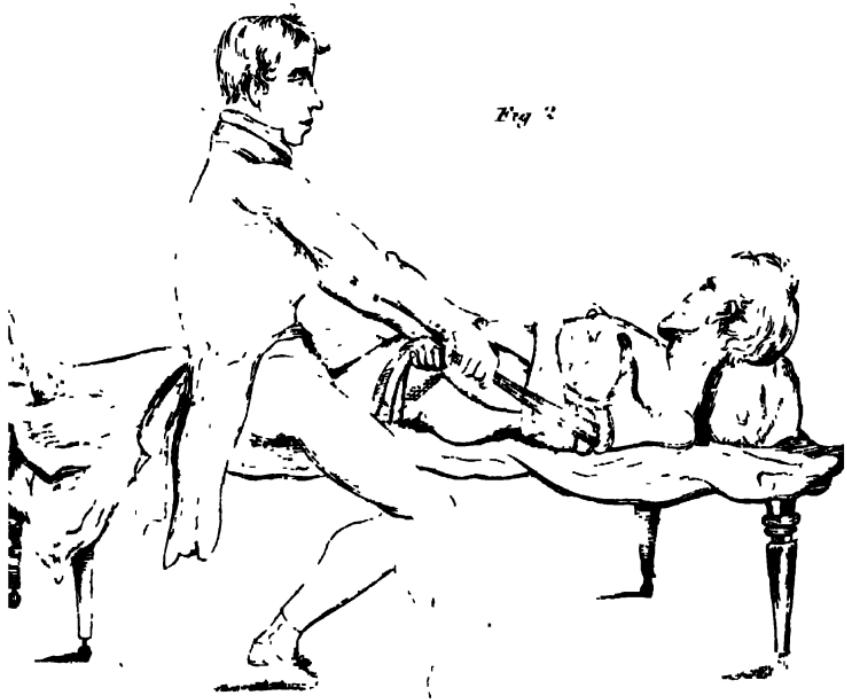


PLATE XI.

FIG. 1. The bones of the trunk, and their situation in certain dislocations of the humerus and clavicle.

- a.* Sternal extremity of the clavicle dislocated upon the sternum.
- b.* The scapular end of the clavicle thrown upon the spine of the scapula.
- c.* The spine of the scapula.
- d* The glenoid cavity.
- e.* The coracoid process of the scapula.
- f.* The head of the humerus dislocated into the axilla.
- g.* The head of the humerus dislocated forwards upon the second rib, under the clavicle, and on the inner side of the coracoid process.

Fig. 2. The method most commonly adopted by Sir A. Cooper in reducing dislocations of the humerus. The heel is placed in the axilla, and the arm extended either from above the elbow or the wrist.

proper cavity. The force of two or more persons may be employed in extending, by means of the towel, if required. I generally bend the fore arm nearly at right angles with the os humeri, because it relaxes the biceps, and consequently diminishes its resistance. I have, in many cases, extended from the wrist, by tying the handkerchief just above the hand, but more force is required in this than in the former mode, although it has this advantage, that the bandage is less liable to slip. In recent cases, it very rarely happens that this mode of extension fails, and it is so easily applied in every situation, that I have recommended all our young men to employ it in the first instance, when called to this accident.

If of some standing If, however, the accident is of several days' standing, and if the muscles have been fixed and rigid, more force than can be applied as above will be required to effect the reduction, and the following means must be resorted to:—

Second mode. The patient must be placed in a chair, and the scapula fixed by a bandage with a slit in it, which admits the arm through it; this must be tied over the acromion, so as to keep it well in the axilla. Next, place a wetted roller round the arm immediately above the elbow, to protect the skin, and upon it fix a very strong worsted tape, by what is termed the clove-hitch. Tie the end of the tape to the vertical line, to relax the deltoid muscles. Two

persons then holding the scapula bandage, should keep it fixed, whilst two others draw from the bandage affixed to the arm with a steady, equal, and combined force. After the extension has been kept up for a few minutes, the surgeon should place his knee in the axilla, resting his foot on the patient's chair ; he should then raise his knee by extending his foot, and at the same time, with his right hand, push the acromion downwards and inwards, by which the reduction will be generally accomplished.

Whilst the extension is kept up, a gentle rotatory motion will diminish the counteracting power of the muscles, and materially expedite the reduction ; but should the force applied in this way not be sufficiently steady and continued, then we must apply the pulleys, not with a view of exerting greater force, but to enable the surgeon to employ it more equally and gradually, to avoid jerks and unequal extension, which, in protracted cases, the efforts of men are sure to produce. If, therefore, I saw a surgeon, as soon as the pulleys were fixed, draw them violently, and endeavour suddenly to reduce the limb, I should not hesitate at once to say, " That gentleman is ignorant of the principle upon which this mechanical power is employed, and has still this part of his profession to learn."

Use of pulleys. The bandages, &c., being applied, as in the last instance, the two staples, which are

is to be seated between
ed in the walls of the

apartment, so that the force can be employed in the same direction as before mentioned. The surgeon should first draw gently and steadily until the patient complains of pain, when he should stop, but not relax the extension. Much advantage may be gained now by conversing with the patient, and directing his attention to indifferent subjects. In two or three minutes he may carefully extend a little more, and then cease again, and so on, until he has made as much extension as he thinks correct, but he should at intervals slightly rotate the limb. Then giving the string of the pulley to an assistant, desiring him not to relax, he should place the knee in the axilla, and press the acromion as before described, when the bone glides into its proper situation, not however with a snap, as when the other means are employed.

^{Hospital treat-}ment In the hospital practice, I usually order the patient to be bled, and put into a warm bath at the temperature of 100° to 110° , giving him a solution of tartar emetic until he becomes nauseated and faint, when he is immediately taken from the bath, and extension employed before he regains muscular power. This plan obviates the necessity of using any great force. Mr. Henry Cline was in the habit of directing his patients to support a weight for a length of time before the extension was begun, with a view of fatiguing the muscles, and lessening their resistance. In a case where it is not convenient to place the pull

in the floor, on each side of the patient, who must, under these circumstances, sit upon the floor.

After-treatment. When the reduction has been effected, a small cushion should be placed in the axilla, and fixed there by a stellate bandage, to prevent the head of the bone again slipping from its situation, which the excessive relaxation of the muscles would readily permit; but the cushion should not be so large as to separate the arm far from the side. The sling is to be also worn to support the arm.

By the knee in the axilla. In very old relaxed persons, or in very delicate females, another mode of reducing this dislocation may be resorted to, by placing the knee in the axilla in the following manner:—The patient should be seated upon a low chair, when the surgeon should separate the injured arm from the side, and then resting his foot upon the chair, should place his knee in the axilla, and holding the arm with one hand over the condyles of the humerus, and pressing the acromion of the scapula with the other, he should then depress the elbow, and thus the dislocation will be reduced.

Use of the Ambe. The Ambe has been recommended for the reduction of dislocations in the axilla, and this instrument was, in the last century, improved by the addition of a screw, for the purpose of rendering its extension more gradual. It may succeed very well in recent cases, and persons whose muscles are not very powerful when a continued exten-

sion must of necessity be used to reduce the bone, as its fixed point of action is upon the ribs of the patient, it produces too much injury to the side, is too painful to be borne long, and is, therefore, an instrument which cannot be recommended for general use.

Mr. Kirby's mode
of reduction. Mr. Kirby, surgeon in Dublin, has lately advised an ingenious mode of applying force in dislocations of the shoulder :—The scapula being fixed, and the bandage applied to the arm, the patient sits upon a mattress which is laid upon the floor, and the assistants, to whose management the extension and counter-extension are consigned, place themselves at his sides, sitting opposite to each other, and disposing their legs so that the soles of their feet are opposed to each other, behind and before the patient. If occasion should require a greater force than the power of two men, the assistants may be increased by placing one or more at the backs of the other two, sitting close up to them, with their faces turned towards the patient; the extension is now made, with the arm raised nearly to a right angle with the body, and in direction, forwards or backwards, as the circumstances of the case may require. The force should be maintained until it is perceived that the head of the bone (which can be easily felt, and should be pressed upon during the operation) has moved from its new situation; and when the head of the bone is found to change its position, the assistants should slowly diminish their force while the

surgeon directs it towards the glenoid cavity, by pressing the elbow to the side of the patient and slightly raising it.

When often dislocated, easily reduced. After frequent displacements of the shoulder, but very slight force is necessary

Case to reduce any future dislocations. A gentleman in the country, of my acquaintance, who has frequently dislocated his shoulder, has often reduced it himself in the following way,—by leaning over one of the common field gates, and laying hold of one of the lower bars, then allowing his body to weigh down on the other side ;—this is on the same principle as placing the heel in the axilla, which will effect the reduction of three-fourths of the recent dislocations.

SECTION II.

DISLOCATION FORWARDS UNDER THE PECTORAL MUSCLE.

Easily detected. This dislocation is much more readily detected than the former. The depression beneath the acromion process of the scapula is greater, and the process itself appears more prominent. The head of the os humeri can be distinctly felt, and, in thin persons, may be seen forming a swelling beneath the clavicle, which moves when the elbow is rotated.

Signs. The head of the bone is situated internal to the corc between it and the



PLATE IX.

Dislocation of the humerus forwards, under the clavicle, and behind the pectoral muscle.

- a. The clavicle.
- b. The scapula.
- c. The acromion.
- d. The glenoid cavity, on the inner side of which is seen the coracoid process.
- e. The head of the humerus, with the tendon of the biceps passing over it; situated on the centre of the scapula, below the middle of the clavicle, and on the inner side of the coracoid process.
- f. Portions of new ligament, enclosing the head of the bone.

(Taken from a preparation in St. Thomas's Hospital.)

sternum, and is covered by the large pectoral muscle. The arm is shortened, and the elbow is separated from the side, being forced outwards and backwards; the motions of the arm are more affected than in the former dislocation, the head of the bone being fixed, by the coracoid process and neck of the scapula on the outer side, by the clavicle above, and by the muscle on the fore part, as well as by the action of the teres minor with the supra and infra spinati muscles, which are rendered very tense. If, therefore, the arm be attempted to be brought forwards, the head of the bone strikes against the clavicle ; if outwards, from the side, the coracoid process stops it ; but its motion backwards is confined, not by bone, but by the resistance of the muscles.

The pain occasioned by this injury is not so severe as in the dislocation into the axilla, because the axillary vessels and nerves are less compressed.

Chief marks. The chief diagnostic marks, are the position of the limb, the elbow being carried from the side and backwards ; the head of the bone being readily felt below the clavicle, and its moving when the arm is rotated.

Dissection. There is in the Museum at St. Thomas's Hospital, a beautiful preparation, showing a dislocation of this kind of long standing, which presents the following appearances :—The head of the humerus rests upon the neck and part of the venter of the scapula, just below the supra-scapular notch ; the

subscapularis muscle has in part been raised so that the head of the bone rests on the scapula ; the subscapularis and serratus magnus muscles being between the extremity of the humerus and the surface of the ribs. The tendons of all the muscles attached to the tubercles, as also that of the long head of the biceps muscle, remain perfect. The glenoid cavity is filled with a ligamentous substance, but its general figure is not much altered ; and to this ligamentous structure the tendons of the supra and infra spinati, and of the teres minor muscles are adherent, having, however, a sesamoid bone formed in them : a new socket has been formed, which extends from the glenoid cavity to the venter of the scapula, occupying about one-third of its width, it has a complete lip, and is irregularly covered with cartilage ; the head of the humerus is a good deal altered in form, and its cartilage has been in many places removed by absorption : a perfect capsular ligament has been formed.

Causes. Violent blows upon the shoulder, or falls upon the elbow, when it is thrown behind the line of the body, are the usual causes of this dislocation.

Reduction of the Dislocation forwards.

When recent. In recent dislocations of the kind, the reduction may be accomplished by placing the heel in the axilla, and making extension from the arm as

before described ; the foot should, however, be placed rather more forwards, to press on the head of the bone, and the arm should be drawn a little backwards as well as downwards.

When of long standing. When the dislocation has existed for some days, it will be best to use the pulleys, as continued and steady extension will be required to reduce it.

Mode of reduction. The scapula must be fixed by the same bandage as formerly described, and the wetted roller, with a strap for the pulleys, fixed on in the same manner above the elbow. The fore-arm should be bent to relax the biceps muscle.

Direction of extension. The most important circumstance, is the direction in which the extension is to be made, which must be outwards, a little downwards and backwards ; for if it be made horizontally, as in the former case, the coracoid process of the scapula prevents the head of the humerus from passing outwards in its proper situation.

When the head of the bone has been brought below the coracoid process by the extension, the surgeon should, with his knee, press it backwards and upwards to the glenoid cavity, at the same time pulling the arm forwards from the elbow, by which means he will expedite the reduction. As the resistance is greater, the extension must generally be continued longer than that required to reduce the dislocation into the axilla.

SECTION III.

DISLOCATION BACKWARDS ON THE DORSUM OF
THE SCAPULA.

Situation of bone. In this dislocation, the head of the humerus is thrown upon the posterior surface of the inferior costa of the scapula, below the spine, where it forms a projection at once perceptible to the eyes of the surgeon; and this enlargement may be seen and felt to move when the elbow is rotated. The motions of the arm are less confined than in either of the former dislocations.

Very rare. Only two cases of this kind has occurred in Guy's Hospital during thirty-eight years. One was during my apprenticeship, and was under the care of Mr. Forster. The nature of the injury was scarcely to be mistaken, on account of the projection formed by the head of the bone upon the posterior part of the scapula. The bandages were applied, and the extension made in the same way as for the dislocation into the axilla, and the reduction was quickly accomplished.

The second case was reduced in the same manner by the dresser; it occurred some years after the former.



PLATE XIV.

DISLOCATION of the humerus upon the dorsum scapulæ.

- a.* The scapula.
- b.* The acromion.
- c.* The spine of the scapula.
- d.* The humerus.
- e.* The head of the bone, situated on the dorsum scapulæ.
- f.* The remains of the capsular ligament.
- g.* The new articular cavity, formed for the reception of the head of the humerus, on the dorsum scapulæ.

(Guy's Hospital Reports, Oct. 1839.)

SECTION IV.

PARTIAL DISLOCATION OF THE OS HUMERI.

Sym. This is an accident of frequent occurrence. The head of the humerus is displaced forwards, and rests against the coracoid process of the scapula; there is a depression under the back part of the acromion, the axis of the arm is directed inwards and forwards, and the under motions of the arm can still be made, but it cannot be elevated, as the head of the bone strikes against the coracoid process, over which it forms an evident projection, moving when the arm is rotated.

Case. Mr. Brown, aged fifty, was thrown from his chaise and injured his shoulder, which upon examination was found to have lost its roundness, and a depression was perceptible under the acromion process; the arm could be moved readily, except directly upwards.

The only opportunity which I have had of seeing the dissection of this accident, was through the kindness of Mr. Paty, surgeon, Bouveric Street; he had the subject brought to him for dissection at St. Thomas's Hospital.

The following is Mr. Paty's account:—

Mr. Paty's dis-
section.

Partial dislocation of the head of the

to St. Thomas's Hospital, during the latter part of the year 1819.

The appearances were as follows :—The head of the os humeri, on the left side, was placed more forwards than is natural, and the arm could be drawn no further from the side than the half way to the horizontal position.

Dissection. The tendons of those muscles which are connected with the joint were not torn, and the capsular ligament was found attached to the coracoid process of the scapula. When this ligament was opened, it was found that the head of the os humeri was situated under the coracoid process, which formed the upper part of the new glenoid cavity ; the head of the bone appeared to be thrown upon the anterior part of the neck of the scapula, which was hollowed, and formed the lower portion of the new glenoid cavity. The natural rounded form of the head of the bone was much altered, it having become irregularly oviform, with its long axis from above downwards ; a small portion of the original glenoid cavity remained, but this was rendered irregular on its surface by the deposition of cartilage ; there were also many particles of cartilaginous matter upon the head of the os humeri, and upon the hollow of the new cavity in the cervix scapulæ, which received the head of the bone. At the upper and back part of the joint, there was a large piece of the cartilage, which hung loosely into the cavity, being connected with the synovial

membrane at the upper part only by two or three small membranous bands. The long head of the biceps muscle seemed to have been ruptured near to its origin, at the upper part of the glenoid cavity; for at this part the tendon was very small, and had the appearance of being a new formation.

Causes. The same causes which produce the dislocation under the clavicle, only with less violence, occasion this displacement.

Reduction. The reduction in these cases may be accomplished by the same means as those directed to employed for the dislocation forwards; but in addition, it is necessary to draw the shoulders backwards, and, after the reduction, a bandage must be applied to keep the head of the bone in its proper situation, and to prevent the motions of the scapulae forwards, or otherwise the bone will again slip out of the glenoid cavity.

SECTION V.

COMPOUND DISLOCATION OF THE OS HUMERI.

Forwards. In the dislocation of the os humeri forwards, the head of the bone may, by excessive violence, be forced through the exterior soft parts.

Treatment. In such a case, the reduction of the displaced bone should be immediately effected by the means I have already recommended for the simple

external wound should be approximated by a suture, and then lint dipped in blood should be applied over the wound, which is to be further supported by strips of adhesive plaster. The limb must be fixed to the side, by a roller passed round it and the body ; this will prevent any motion of the limb, and thus there will be less risk of the suppurative inflammation occurring, which would greatly endanger the patient's life.

Mr. Dixon's
case. Mr. Dixon, of Newington, kindly furnished me with the following particulars of a case which was under his care :—

Robert Price, aged fifty-five, fell, when in a state of intoxication, upon his shoulder, which produced a dislocation of the humerus, and forced the head of the bone forwards, through the integuments of the axilla ; and I found it situated on the anterior part of the thorax, over the large pectoral muscle. The reduction was accomplished with great ease, after which he was placed in bed, and an evaporating lotion was applied. The following morning he complained of great pain, and considerable swelling had taken place ; for this he was fled and purged freely, the injured part was poulticed, and anodynes were given to relieve pain and procure rest. For several days afterwards, leeches were repeatedly and freely applied over the joint, until after about two weeks from the receipt of the injury, when the wound began to discharge very freely a healthy pus. This continued

for ten or twelve weeks, during which time his constitution suffered much; he was restless, irritable, and became emaciated. A number of small abscesses afterwards formed in the surrounding cellular tissue, occasioning sinuses, of which, some were exceedingly troublesome, and required dilatation. This was kept up for twelve months, when all discharge ceased, but the joint was completely ankylosed. He retained, however, perfect use of the fore-arm and hand.

CHAPTER IX.

SECTION I.

STRUCTURE OF THE ELBOW JOINT.

Bones. THIS joint is composed of three bones :—the lower extremity of the humerus,—the upper part of the ulna, and the head of the radius. The extremity of the os humeri is expanded, and presents two lateral eminences, which are called its condyles, the internal of which is the most prominent. Between these condyles is situated the articular surface for the ulna, in form resembling a pulley; and above it, both anteriorly and posteriorly, is situated a deep cavity with a thin partition intervening. On the lower extremity of the external condyle is placed an articular surface, on which the head of the radius is received.

The upper extremity of the ulna presents two processes, with an articulatory surface between them, which is adapted to the pulley-like articular surface of the os humeri. Both these surfaces of the ulna and humerus are covered with cartilage. The superior and posterior process of the ulna is called the *olecranon*, which forms the point of the elbow and

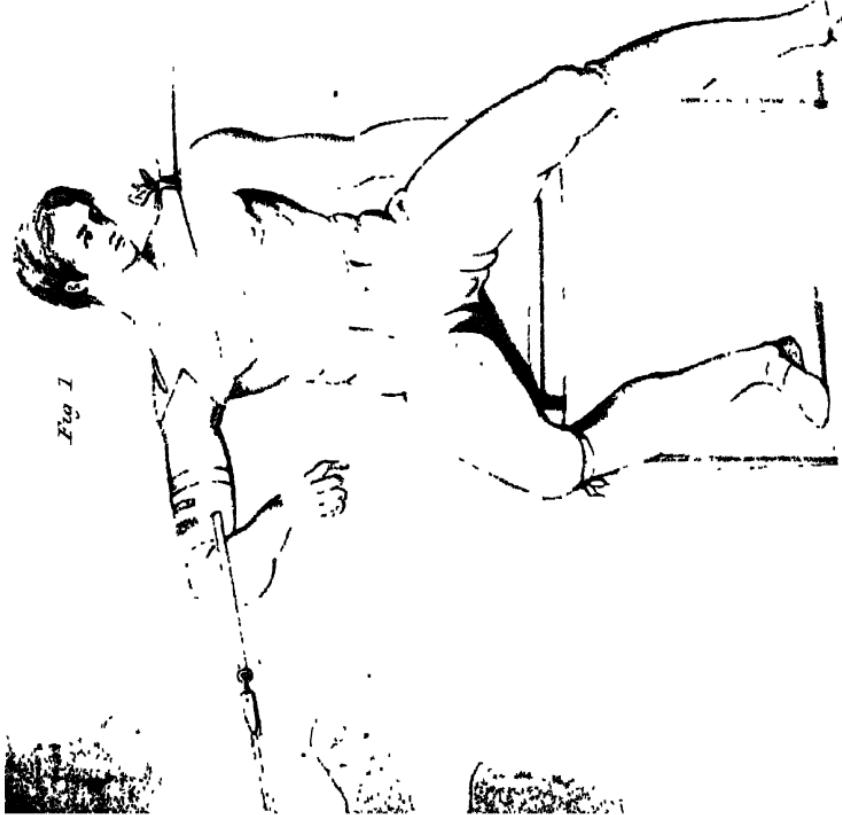


PLATE XII.

FIG. 1. Shows the mode of reduction by pulleys. The scapula is fixed by a bandage, which receives the arm; and extension is made by means of pulleys applied above the elbow. In cases of dislocation into the axilla, the direction here indicated is that in which extension ought to be made; but when the humerus is dislocated forwards under the clavicle, the arm should be lowered during extension, for the purpose of avoiding the coracoid process.

Fig. 2. Shows a convenient mode of reducing dislocations of the humerus where muscular resistance is not great. The knee is placed in the axilla as a fulcrum, and the surgeon, grasping the shaft of the humerus, uses it as a lever to replace the head of the bone in its proper cavity.

into which the triceps muscle is inserted; the anterior and smaller process is called the coronoid, and gives insertion to the brachialis internus.

When the arm is extended, the point of the olecranon is received into the posterior cavity, between the condyles of the humerus; and, when it is flexed, the coronoid process passes into the anterior hollow; these cavities are formed therefore for the purpose of admitting of free extension and flexion of the arm. The head of the radius is rounded, and rests upon the broad articular surface of the humerus, upon which it bends; and, on its inner side, it is received into an articular cavity on the radial side of the coronoid process of the ulna, upon which the radius rolls; and thus all the motions of the fore-arm are performed: immediately below its head the radius becomes smaller, and this part is called its cervix; at the distance of an inch below its head is seated a process which is called its tubercle.

Ligaments. The ligaments which bind these bones together, are, the *capsular*, *coronary*, *brachio-cubital*, *brachio-radial*, oblique, and a *ligamentous band* extending from the coronoid process to the olecranon.

Capsular. The *capsular* ligament is united with the condyles, and portion of bone above the cavities of the os humeri. It passes over the extremity of the humerus, and is united, behind, to the olecranon; and, on the fore part, to the coronoid process

of the ulna; it is also connected to the coronary ligament of the radius. This ligament, posteriorly, is loose and slender, but, on the fore part, is of considerable strength.

Coronary. The *coronary* ligament surrounds the head of the radius; it is connected above with the capsular ligament, and below with the neck of the radius, by a thin ligament of sufficient length to allow of rotation of the head of the bone; it is also attached to the fore and back part of the coronoid process of the ulna, at its lateral articular surface, and thus firmly unites the radius with the ulna, yet allows of the rotation of the former.

Brachio-radial The *brachio-radial*, or external lateral ligament, is fixed to the external condyle of the humerus, and to the coronary ligament of the radius, giving to the joint a strong lateral support.

Oblique. The *oblique* ligament passes from the coronoid process of the ulna to the radius, just below its tubercle; and it is this ligament which limits the rotation of the radius.

A ligament also reaches from the inner side of the coronoid process to the olecranon; and when this latter process is broken off, it is this ligament which, in some instances, prevents its extensive separation.

Muscles. The muscles of this joint are;—first, the *brachialis internus*, which, passing over the anterior part of the condyles, and capsular ligament, to which it is attached, is inserted in an oblique direction into

the coronoid process, and into the body of the ulna just below it : the use of this muscle is to bend the fore-arm, and give support to the elbow joint, by strengthening the capsular ligament. The next muscle is the *triceps*, which, arising by one of its heads from the inferior costa of the scapula, and by its two others from the os humeri, descends to the capsular ligament, to the loose portion of which it adheres, and is inserted into the point of the olecranon : this muscle extends the arm, and draws up and supports the capsular ligament. Thirdly, the *anconeus*, which arises from the back part of the external condyle of the humerus, adheres to the capsular ligament, and is inserted to the extent of an inch and a half into the body of the ulna, directly below the olecranon ; the course of this muscle is oblique ; and, whilst it extends the arm, it supports the capsular ligament. The *biceps* muscle does not protect the ulna joint, but has great influence in preventing a dislocation of the radius forwards, in the extended state of the arm. It is not connected with the capsular ligament, as the other muscles are ; but arising tendinous from the glenoid cavity, and coracoid process of the scapula, it becomes fleshy in its middle and again forms a tendon at the elbow joint, which is fixed into the tubercle of the radius. This muscle bends the fore-arm, rotates the radius outwards, that is, supines the hand, and compresses the capsular ligament opposite the head of the radius.

*Dislocations of
elbow joint.* The elbow may be dislocated in five different directions.

- 1st. The ulna and radius backwards.
- 2nd. The ulna and radius laterally.
- 3rd. The ulna separately from the radius.
- 4th. The radius alone forwards.
- 5th. The radius alone backwards.

SECTION II.

DISLOCATION OF BOTH BONES BACKWARDS.

Symptoms. This injury is strongly marked by the great change in the figure of the joint, and by the destruction of its principal motions. The ulna and radius form a considerable projection above the natural position of the olecranon posteriorly, with a depression on each side. On the fore part, the extremity of the humerus occasions a swelling, behind the tendon of the biceps muscle. The flexion of the joint is almost destroyed, and the fore-arm and hand are fixed in a supine position.

Dissection. In the museum at St. Thomas's Hospital, there is a preparation, showing the effects of a compound dislocation of this kind, which I had an opportunity of dissecting. The olecranon projected one inch and a half above its usual position, posteriorly, and the coronoid process of the ulna rested in the posterior fossa of the humerus. The radius was

thrown upon the back part of the external condyle of the humerus. The condyles themselves formed a large swelling anteriorly. The capsular ligament was lacerated extensively anteriorly, but the coronary ligament remained entire. The brachialis anticus muscle was greatly stretched, and the biceps moderately so, by the altered position of the radius and ulna.

Cause. This accident is produced by a severe fall, when the person puts out the hand to save himself; the whole weight of the body being received upon the limb, before it is perfectly extended, the radius and ulna are forced backwards and upwards, behind the humerus.

Mode of reduction. The reduction of this dislocation may be readily accomplished by the following means. The patient being seated on a chair, the surgeon should lay hold of his wrist, and placing his own knee on the inner side of the elbow joint, press down the ulna and radius with his knee, so as to separate them from the humerus; then bending the arm gradually and firmly, the coronoid process is removed from the posterior fossa of the humerus, and, by the action of the muscles, the bones are drawn into their proper situations. Bending the arm around a bed-post, or over the back of a chair, will also effect the reduction.

This dislocation is sometimes undiscovered at first, in consequence of the great tumefaction which imme-

216 DISLOCATION OF ULNA, ETC., LATERALLY.

dately succeeds the injury. But this circumstance does not prevent the reduction, even at the period of several weeks after the accident: for I have known it to be effected even then by bending the limb over the knee, without the application of very great force.

After-treatment. After the reduction, the arm should be bandaged in the bent position, at rather less than a right angle with the upper arm; the bandage should be kept wet with an evaporating lotion, and the limb supported by a sling. A splint may be placed in the sling, for the better support of the limb.

SECTION III.

DISLOCATION OF THE Ulna AND RADIUS LATERALLY.

External or internal. This dislocation may take place either externally or internally; in one case the ulna is thrown upon the external condyle of the humerus, and in the other instance, upon the internal condyle.

Signs of external. In the external displacement, the olecranon forms a greater projection than in the dislocation backwards; as its coronoid process is seated upon the external condyle of the humerus, instead of being placed in its posterior fossa. The head of the radius is thrown to the outer side, and behind, where it forms a swelling, which moves when the hand is rotated.



PLATE XV.

FIG. 1. Dislocation of the ulna and radius backwards.

- a.* The humerus.
- b.* The ulna.
- c.* The radius.
- d.* The tendon of the biceps.
- e.* The tendon of the brachialis internus.
- f.* The triceps.
- g.* The internal condyle of the humerus.
- h.* The olecranon thrown behind the articular surface of the humerus.
- i.* The coronoid process of the ulna resting in the posterior cavity of the humerus.

(From a preparation in St. Thomas's Hospital.)

Fig. 2. Dislocation of the ulna backwards.

- a.* The humerus.
- b.* The ulna.
- c.* The radius.
- * *d.* The insertion of the biceps into the tubercle of the radius.

EXPLANATION OF PLATE XV.

- e.* The olecranon dislocated behind the humerus.
- f.* An appearance of injury to the internal condyle of the humerus.

(From a preparation in St. Thomas's Hospital.)

Of Internal. When dislocated internally, the olecranon projects equally as in the former case ; but the head of the radius falls into the posterior fossa of the humerus. The external condyle of the humerus forms a large protuberance on the outer side.

Cause. This accident is produced in the same way as the former, only that the direction of the limb at the time varies. It is also caused by the wheel of a carriage passing over the arm, whilst it is placed upon uneven ground.

Reduction. The reduction in these cases may be effected by the method described as proper for the dislocation backwards : it is not necessary to move the fore-arm outwards or inwards, as the actions of the biceps and brachialis anticus muscles draw the bones into their natural positions, immediately that they are separated from the extremity of the humerus.

Case. In a recent case of this dislocation, in a lady, I speedily reduced it by forcibly extending the arm ; when the tendons of the biceps and the brachialis anticus muscles acted as strings from a pulley, and forced the condyles of the humerus backwards.

SECTION IV.

DISLOCATION OF THE Ulna Backwards.

Signs. The ulna is sometimes thrown backwards upon the os humeri, the radius remaining in

its natural situation : in these cases, the olecranon forms a projection behind, and the fore-arm and hand are twisted inwards, producing considerable deformity. The fore-arm cannot be brought to more than a right angle with the upper arm, without considerable force.

It is not so readily detected as the former injuries ; but its chief diagnostic marks are the projection of the ulna, and the turning of the fore-arm inwards.

Dissection of. A preparation in the museum at St. Thomas's Hospital affords an excellent opportunity of viewing the nature of this dislocation. The displacement had existed for a long time unreduced. The coronoid process of the ulna rests in the posterior fossa of the humerus ; the olecranon projects behind the os humeri ; the head of the radius has made a considerable depression in the external condyle. The coronary, oblique, and a small portion of the interosseous ligaments have been torn through.

Cause. This dislocation is produced by the application of violence in the direction of the lower extremity of the ulna, which forces it suddenly upwards and backwards.

Reduction of. The reduction is in this case much more readily made than when both bones are displaced, and by the same means. The radius assists the return of the ulna to its proper position, by pushing the condyles back, when the fore-arm is bent, and the

brachialis anticus acts at the same time in drawing the ulna forwards.

SECTION V.

DISLOCATION OF THE RADIUS FORWARDS.

Situation of one. The head of the radius is sometimes separated from its attachment to the coronoid process of the ulna, and is displaced into the depression above the anterior part of the external condyle of the humerus, and also above the coronoid process.

Signs of. I have seen several cases of this injury, which exhibits the following marks. The fore-arm is a little bent, but cannot be either completely flexed or extended. When an attempt is made to bend the fore-arm, the motion is suddenly stopped by the striking of the radius against the humerus, and the surgeon is immediately convinced that this check to the flexion is by the striking of one bone upon another. The hand is nearly in a state of complete pronation, but cannot be rendered entirely so, nor can it be placed in a supine position. The head of the radius may be felt on the fore and upper part of the elbow-joint, and its movements are perceptible when the hand is rotated.

The sudden stop to the flexion of the fore-arm, and the situation of the head of the radius, are the most distinguishing marks of this injury.

Dissection of. On dissecting this injury, the head of the radius is found resting in the depression above the external condyle of the humerus. The coronary, the oblique, with part of the interosseous, and the anterior portion of the capsular ligaments are lacerated. The biceps muscle is shortened.

Cause. The dislocation is occasioned by a fall upon the hand when the limb is fully extended, the weight of the body being received upon the inferior extremity of the radius.

Case. The first case I had an opportunity of seeing of this accident, occurred under the care of Mr. Cline, during my apprenticeship to him, at St. Thomas's Hospital. The most varied attempts, which his strong judgment could suggest, were made to reduce the displacement, but without success; and the woman was discharged with the bone still displaced.

Case. The second case which I witnessed was in a lad, whom I was asked to visit by Mr. Ballmanno, in Bishopsgate Street; but I could not succeed in reducing the dislocation although I persevered, with varied modes of extension, for more than an hour and a quarter.

Case. In the third case, I succeeded in replacing the bone during the time that the patient was in a state of syncope; by resting his olecranon upon my foot, (as he lay upon the floor,) to prevent the ulna from receding, and then extending the fore-arm.

case. Another case which I attended with Mr. Gordon, was reduced by placing the arm over the back of a sofa, thus fixing the humerus, whilst we made extension from the hand so as to act alone on the radius.

case. Mr. Tyrrel informed me that a sailor, about thirty years of age, applied at St. Thomas's Hospital with a dislocation of the radius forwards, which had existed above six months. He could readily feel the head of the radius above the external condyle, particularly when he bent the arm as much as possible, and flexed the hand towards the fore-arm. The hand was half supine, and could not be placed entirely in the supine or prone positions, if the humerus was fixed. A sudden stop was experienced when bending the arm, by the head of the radius striking upon the humerus. The man had regained a great degree of motion, yet was extremely anxious for Mr. Tyrrel to attempt the reduction, which he declined, and urged him not to allow any one to make the trial, as he was confident it would have been useless.

Best mode of extension. One evening, after I had lectured upon this subject and had explained the difficulties of reduction, Mr. Williams, one of my pupils, told me that he had known this dislocation reduced by extending the hand only. This I soon convinced myself was correct, by experiments on the dead body. The connection of the hand with the radius allows of the application of force, to extend this bone, without in-

cluding the ulna. In making the extension the humerus should be fixed, and the hand rendered as much as possible supine, to remove the head of the radius from the upper part of the coronoid process of the ulna.

SECTION VI.

DISLOCATION OF THE RADIUS BACKWARDS.

Very rare. The only instance in which I have seen this dislocation, was in a subject brought to St. Thomas's dissecting room, in the year 1821; the displacement had existed some time.

Signs of. The head of the radius was thrown behind, and to the outside of the external condyle of the humerus, where it formed a projection which could be readily seen as well as felt, when the arm was extended. The oblique and coronary ligaments were torn through, and the capsular ligament was partially lacerated.

Of the cause of this accident I am ignorant, as I have never seen the accident in the living subject.

Reduction. The reduction, I should imagine, would be easily effected by bending the arm, after which it would be proper to support the bone in its proper position, by means of bandages, and keep the arm bent at right angles, for three or four weeks, until the ligaments have had time to unite.

SECTION VII.

LATERAL DISLOCATION OF THE RADIUS.

Mr Freeman, Surgeon, of Spring Gardens, brought to my house a gentleman of the name of Whaley, aged twenty-five years, whose pony having run away with him, when he was twelve years of age, he had struck his elbow against a tree whilst his arm was bent and advanced before his head. The olecranon was broken, and the radius dislocated upwards and outwards, above the external condyle, and when the arm is bent, the head of the radius passes the os humeri. He has a useful motion of the arm, but neither the flexion nor the extension is complete.

SECTION VIII.

COMPOUND DISLOCATION OF THE ELBOW-JOINT.

Mr. White has furnished me with the particulars of a case of this kind that was brought to Guy's Hospital, during his dressership, in 1822.

In this case, the condyles of the humerus were thrown inwards through the skin ; the articular surface receiving the sigmoid cavity of the ulna being completely exposed to view : the ulna was dislocated backwards, and the radius outwards ; the lateral and capsular ligaments were torn asunder, with extensive

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laceration of the parts about the joint, but the artery and nerve remained perfectly free from injury.

The reduction was easily effected ; by grasping the humerus above its condyles ; and gradually extending the fore-arm from the position in which it was found, (at right angles,) the parts returned to their natural position. The arm was then dressed with adhesive plaster, in the semiflexed position ; a pasteboard splint, previously soaked in warm water, so as to give it pliability, was adjusted to the parts by means of a roller ; motion of the arm was further prevented by a sling.

Under antiphlogistic treatment, the case proceeded favourably for about a fortnight ; when an abscess formed upon the external condyle, from which about two ounces of healthy pus were discharged. The case continued to improve from this time, and in about six weeks from the first receipt of the injury he was able to leave his bed, and walk about the ward. By great attention to the use of passive motion, he is now enabled to move the joint to a considerable extent.



Fig. 2

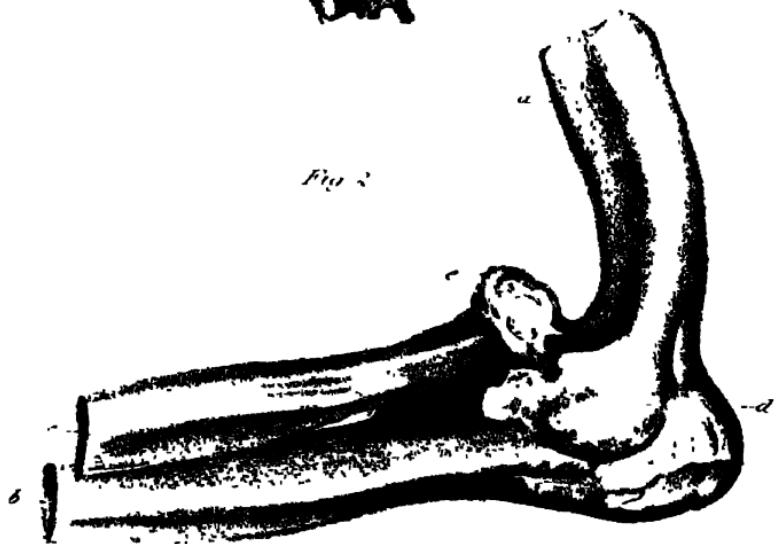


PLATE XIII.

FIG. 1. Dislocation of the radius outwards.

- a.* The humerus.
- b.* The radius.
- c.* The ulna.
- d.* The internal condyle of the humerus.
- e.* The coronoid process of the ulna, with the capsular ligament cut open to show *d* and *e*.
- f.* The head of the radius, dislocated backwards and to the outer side of the external condyle of the humerus.
- g.* The coronary ligament torn through.

(From a preparation in St. Thomas's Hospital.)

Fig. 2. Dislocation of the radius upon the external condyle, and coronoid process of the ulna.

- a.* The humerus.
- b.* The ulna.
- c.* The radius.
- d.* The olecranon.

EXPLANATION OF PLATE XIII.

e. The head of the radius, situated on the coronoid process of the ulna and external condyle of the humerus. The coronary ligament, and a part of the interosseous ligament is torn through.

(From a preparation in St. Thomas's Hospital.)

CHAPTER X.

SECTION I.

STRUCTURE OF THE WRIST-JOINT.

^{Radio-carpal articulation.} THE radius, and the first three bones of the carpus, form the articular surface of the wrist-joint; the radius having an oval cavity at its lower extremity; which receives the rounded surfaces of the scaphoid, lunar, and cuneiform bones. The articular cartilage which covers the surface of the radius is, at its inner edge, extended beneath the ulna, so as to exclude that bone from the general cavity of the wrist-joint. This articular cartilage is hollow both above and below, and at its lower surface, rests upon the os cuneiforme.

^{Capsular ligament.} A capsular ligament passes from the edge of the articular cavity of the radius, and from the inter-articular cartilage of the ulna to the first three bones of the carpus, surrounding a large portion of the scaphoid and lunar bones, and but a small surface of the os cuneiforme.

^{Radio-ulnar articulation.} The second joint at this part is formed between the radius and the ulna. On the inner side of the lower extremity of the radius is situ-

ated a hollow articulatory surface, which receives an articular surface on the outer side of the ulna, and both are covered by an articular cartilage. At the lower part of this joint is placed the inter-articular cartilage of the ulna, the outer edge of which is joined to the articular cartilage of the radius, and its inner edge is united to the ulna by ligament, which sinks into a cavity formed at the lower extremity of this bone, between the styloid process of the ulna and its rounded extremity.

Sacciform ligament.—The capsular ligament which unites the ulna to the radius, is called the *sacciform ligament*; it covers the articular surfaces of the two bones, and is united below to the moveable cartilage of the ulna. This joint of the wrist is formed for the purpose of supporting the rotatory motion of the radius upon the ulna, and of strongly uniting one bone to the other.

Peculiar ligaments.—The wrist is strengthened on each side by peculiar ligaments; one proceeds from the styloid process of the radius, to be fixed to the outer edge of the scaphoid bone, which is the *radius-carpal ligament*; and an *ulna-carpal ligament*, which extends from the styloid process of the ulna, to the os cuneiforme and os orbiculare.

Dislocations of the wrist-joint.—Dislocations of this articulation may occur in three ways:—

First.—Dislocation of the ulna and radius together.

Second.—Dislocation of the radius alone.

Third.—Dislocation of the ulna alone.

SECTION II.

DISLOCATION OF THE ULNA AND RADIUS.

^{Forwards or} These bones may be displaced from the connexion with the carpal bones, either forwards or backwards. If a person, in falling, receives the weight of the body upon the palm of the hand, so as to occasion a dislocation, it will be forwards ; the radius and ulna resting upon the anterior annular ligament of the carpus : should the fall, however, be upon the back of the hand, the contrary displacement may be produced.

^{Signs of} In each of these cases, two projections are perceptible, anteriorly and posteriorly, one from the extremities of the radius and ulna, the other from the bones of the carpus, which render the detection of either injury easy.

^{Injury resu-}
^{bling dislocation.} The effusion which so frequently follows sprains of the tendons, frequently produces an appearance somewhat similar to that resulting from dislocation ; it may, however, be distinguished from that occasioned by dislocation, as it takes place gradually, and is rarely found on both sides,—whereas, in the displacement, the projections im-

mediately follow the accident, and appear both anteriorly and posteriorly.

Reduction. These dislocations may be easily reduced, by fixing the fore and upper arm, whilst extension is made from the hand; immediately that the ends of the bones are separated from each other, the actions of the muscles restore them to their proper situations. When replaced, they must be supported by bandages and two splints; one placed before and another behind the articulation, and reaching from the elbow to the ends of the metacarpal bones, to prevent motion, as well as to protect the injured parts. The fore arm and hand should be placed in a sling.

SECTION III.

DISLOCATION OF THE RADIUS ALONE.

Forwards. The radius is sometimes thrown from its articular surface anteriorly, so as to rest upon the scaphoid and trapezium, where it forms a projection; the hand is twisted, the inner side of the palm being placed forwards.

Cause of. A fall upon the hand, when it is bent back, is the common cause of this injury.

Reduction. It may be reduced by the same means as the former dislocation, and will require the same after treatment.

SECTION IV.

DISLOCATION OF THE ULNA ALONE.

Backwards. The displacement of the ulna alone, occurs much more frequently than that of the radius alone ; the mode in which the former bone is articulated by means of an inter-articular cartilage, and its not forming a part of the wrist-joint, allows of its being more readily thrown from its natural position. It usually projects backwards, and is attended with laceration of the sacciform ligament. It may be easily pressed into its proper situation, but immediately the pressure is discontinued, it again protrudes, as the support of the ligament is destroyed.

Treatment. In the treatment of the injury, it is therefore necessary to employ a compress over the extremity of the ulna, and then to support the bone in its natural position, by bandages and splints, as in the former dislocation.

SECTION V.

DISLOCATIONS OF THE ULNA, WITH FRACTURE OF
THE RADIUS.

The ulna is often dislocated forwards, the radius being at the same time fractured obliquely, about an inch above the articulation.

Signs of. The hand is, in these cases, thrown backwards, as in the dislocation of both bones forwards ; the extremity of the ulna can be felt just

above the pisiform bone, beneath the tendon of the flexor carpi ulnaris, and the fractured extremity of the superior portion of the radius is situated under the flexor tendons of the hand.

Reduction. · The reduction in these cases is usually very difficult, requiring powerful extension ; and there exists a further difficulty in preserving the proper position, when the reduction has been effected, as the bones are again displaced from the slightest cause, unless confined by bandages, &c. The extension should be made as in the former cases, and when the bones have been drawn into their natural situations, two cushions must be placed, one before and the other behind the articulation, and there firmly bound down by a roller ; over these, splints, lined with pads, should be placed, to reach from the elbow to the hand, and secured by a long roller. . The arm must be placed in a sling for three weeks, if the patient be young ; or from four to five weeks if aged, before passive motion be resorted to for the purpose of restoring the motions of the joint, which will not be perfectly effected under four or five months.

SECTION VI.

COMPOUND DISLOCATION OF THE ULNA, WITH FRACTURE OF THE RADIUS.

Consequences. The consequences of this injury are serious or not, according to the degree of surround-

ing mischief, and the extent of the fracture ; if comminuted, the subsequent inflammation is severe, but otherwise of trifling extent, when judicious treatment is adopted.

Reduction. The reduction is to be accomplished as when the simple dislocation and fracture occur ; the edges of the wound must be carefully approximated, and every means taken to promote adhesive inflammation, and to keep it within bounds by evaporating lotions, and the employment of leeches if necessary. The arm must be laid on a splint, and supported by a sling. The dressings should not be disturbed so long as the patient remains free from suffering, or until the wound has united; should symptoms of suppuration occur, the removal of part of the dressings may be sufficient to allow the escape of the pus, without taking off the whole.

CHAPTER XI.

SECTION I.

STRUCTURE OF THE CARPAL JOINT.

THE eight bones of the carpus are joined to each other by short ligaments, which pass from bone to bone, allowing but a very slight degree of motion of one bone upon another; but, beside this mode of articulation, there is a transverse joint between the first and second row of carpal bones, forming a complete ball and socket. The ball is produced by the rounded extremities of the os magnum and os unciforme: the cup by the scaphoid, lunar, and cuneiform bones. A ligament passes from one row of bones to the other, including this articulation.

SECTION II.

DISLOCATION OF THE CARPAL AND METACARPAL BONES.

Very rare.

This injury is of very rare occurrence.

Case.
An elderly woman was admitted into Guy's Hospital, in consequence of an accident to her wrist, produced by a fall upon the back of her hand; the radius was found to be fractured obliquely through its inferior extremity, and the part

thus separated from the shaft of the bone, was thrown backwards upon the carpus with the scaphoid bone. The fingers could be completely extended, but only semiflexed. The reduction was readily accomplished by extension and steady pressure, and the part supported by splints. Leeches and evaporating lotions were employed at first, to subdue the inflammation and tumefaction which followed the injury, and afterwards, further support was given by strips of soap plaster.

Ganglia. I have known ganglia, which so frequently form about this part, to be several times mistaken for displaced bones; but a little attention to the history of the case will readily explain the difference.

Partial dislocation. Relaxation of the carpal ligaments will sometimes admit of a partial dislocation of some of the bones, when the joint is forcibly flexed; and this state is generally accompanied with great debility of the part, preventing the patient from any continued exercise of it.

Treatment. Moderate pressure and support are the best means of relieving such complaints, the use of friction and of cold water poured from a height upon the part, I have also known to be of service.

SECTION III.

COMPOUND DISLOCATION OF THE CARPAL BONES.

Causes. This frequently happens from the bursting of guns, or from the hand and wrist being

caught in machinery, and in such cases, one or two of the carpal bones may be removed, and a considerable degree of motion be afterwards preserved in the articulation ; but, if attended with extensive surrounding mischief, amputation should be performed.

Case. The following case occurred under the care of Mr. Forster, in Guy's Hospital. Richard Mitchell, aged 22, was admitted into the Hospital in consequence of an extensive wound in the wrist joint, inflicted by a wool combing machine. Two-thirds of the joint were opened, and the surrounding soft parts had suffered considerably. The scaphoid bone was dislocated backwards, and nearly separated from its usual connexions ; the extensor tendons of the thumb, of the fore and middle fingers were torn through, as was also the radial artery, which, however, did not bleed much. The scaphoid bone was removed, and the edges of the wound were approximated by sutures, and adhesive plaster applied in strips ; the whole was covered by lint dipped in blood, and supported upon a splint to prevent any motion of the joint ; a small quantity of blood was taken from the arm, and the seat of injury kept moistened with an evaporating lotion. In two or three days it became necessary to remove these dressings in consequence of suppuration, when a poultice was applied. A small slough which had formed, separated kindly, and the process of granulation went on without a check, so as to fill up the wound

in the course of three weeks. His recovery was somewhat retarded by the occurrence of a pulmonary affection, requiring the use of leeches, diaphoretics, &c., to which it yielded. He left the Hospital, with but little motion of the fingers, but this appeared to be gradually increasing.

SECTION IV.

DISLOCATION OF THE METACARPAL BONES.

Articulation strong. The articulation of these bones with the carpal is so strong, that great violence is requisite to separate them. I have seen them displaced from the bursting of guns, or the passage of a heavy laden carriage over the hand.

Removal of bones. In these cases, one or more of the metacarpal bones may be removed without amputating the whole hand.

Case. I amputated the middle and ring fingers, with their metacarpal bones, from the hand of a Mr. Waddle, of Cheapside, in consequence of their being extensively injured by the bursting of a gun. I brought the edges of the wound together by sutures, and approximated the fore and little fingers by a roller; the wound united readily, and he had afterwards a very useful extremity.

Case. A boy was admitted into Guy's Hospital with a very severe injury to the hand, from the bursting of a gun, by which all the metacarpal bones,

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excepting that of the fore finger, were so shattered, as to render it impossible to save them. The thumb had been entirely separated, with its metacarpal bone, and the trapezium was so much injured, that I thought it proper to remove it; I therefore took it away, as well as the metacarpal bones of the middle, ring, and little fingers, with the fingers themselves; thus only leaving the fore finger with its metacarpal bone. He recovered quickly, and could use this finger as a hook, with the greatest facility and advantage*.

* A case somewhat similar to the above, occurred under the care of Mr. Tyrrell, in St. Thomas's Hospital, in which he was obliged to amputate the middle and ring fingers of the injured hand, with their metacarpal bones. He also removed the unciform bone, and the middle finger, with two-thirds of its metacarpal bone. The recovery was gradual, but complete, and the patient can now use his thumb and fore-finger very expertly.



PLATE XVI.

FIG. 1. Dislocation of the second phalanx of the finger forwards, and of the first backwards.

- a.* The first phalanx.
- b.* The second phalanx.
- c.* The third phalanx.
- d.* Dislocated extremity of the first phalanx.
- e.* Dislocated extremity of the second phalanx.
- f.* New capsular ligament covering the ends of the dislocated bones.

Fig. 2. Compound dislocation of the first phalanx of the thumb.

- a.* The metacarpal bone.
- b.* The first phalanx thrown backwards.
- c.* The second phalanx.
- d.* The dislocated extremity of the first phalanx.
- e.* The tendon of the flexor longus pollicis torn through.

(From a preparation in St. Thomas's Hospital.)

Fig. 3. Mode of reducing dislocation of the thumb.

Fig. 4. A loop used for the foregoing purpose, and called by sailors the *clove-hitch*. It consists of two circles with the ends between them.

CHAPTER XII.

SECTION I.

STRUCTURE OF THE ARTICULATION.

THE phalanges of the fingers and of the toes are united by capsular ligaments to the metacarpal and metatarsal bones, and to each other ; and their union is further strengthened by lateral ligaments, proceeding from the side of one phalanx to the other. Posteriorly, they are defended by the tendon of the extensor muscles of the fingers or toes ; and anteriorly, by the thecae and flexor tendons.

SECTION II.

DISLOCATIONS OF THE FINGERS.

Common seat of. The most frequent seat of this displacement is between the first and second phalanges ; but it is not an accident of common occurrence.

Nature of. The dislocation may occur either backwards or forwards, when the projections formed by the ends of the bones plainly indicate the nature of the injury.

Reduction. If recent, the reduction may be easily accomplished, by making extension with a slight in-

238 DISLOCATION FROM CONTRACTION, ETC.

clination forwards, to relax the flexor muscles; if of some days standing, a long continued, and steady extension, is necessary to replace the bones. It has been recommended, in cases of difficulty, to divide the ligaments or tendons, but I have seen too much mischief result from injuries to these parts, ever to advise such a practice.

Remarks apply
to injuries of
toes. The same observations are applicable to the dislocations of the toes, but rather more difficulty is experienced in the reduction, on account of the shortness of the phalanges.

SECTION III.

DISLOCATION FROM CONTRACTION OF THE TENDON.

Cause. The phalanges are sometimes drawn out of their proper positions, by the contraction of a flexor tendon and its theca, in consequence of a chronic inflammation, induced by excessive employment of the hand in rowing, ploughing, hammering, &c.; nothing can be done to relieve these cases, but when merely a single band of fascia is thickened, and produces this deformity, it may be divided with much advantage by a narrow bistriety, introduced by a small opening through the skin. A splint must afterwards be applied, to keep the finger straight during the healing of the wound.

In the toes. A similar contraction also occurs in the

tendons of the toes from the wearing of tight shoes; the projection of the first and second phalanges, in these cases, often gives rise to so much suffering and inconvenience, as to make it necessary to amputate the toe, otherwise the patient cannot take necessary exercise, and is deprived of many enjoyments. The cases in which I have performed the operation, have generally done extremely well, and restored the patients to comfort.

SECTION IV.

DISLOCATIONS OF THE THUMB.

a. Structure of the Joint.

The thumb consists of three bones: its metacarpal bone, and two phalanges. The metacarpal bone of the thumb is articulated with the os trapezium by means of a double pulley; that of the trapezium directing the thumb towards the palm of the hand, and that of the metacarpal bone directing it laterally. The metacarpal bone is connected with the os trapezium by a capsular ligament, and a very strong ligament joins the first phalanx to the palmar part of the trapezium, at its lower extremity. The metacarpal bone forms a rounded projecting articulatory surface, upon which the hollow of the first phalanx rests, both being surrounded by a capsular ligament, and strengthened by two strong lateral ligaments.

Muscles. There are eight muscles inserted into the thumb; two into the metacarpal bone, as the extensor and flexor ossis metacarpi; two into the first phalanx, the flexor brevis pollicis and the extensor primi internodii; the abductor and adductor pollicis are also inserted into the first phalanx, through the medium of the sesamoid bones; the extensor secundi internodii and flexor longus pollicis are inserted into the second phalanx.

Muscular connexion strong. The number of strong muscles connected with the bones of the thumb, render the reductions of their dislocations very difficult, especially when much time has been allowed to elapse from the receipt of the injury.

b. Dislocation of the Metacarpal from the Carpal Bone.

Form of. In the majority of cases in which I have witnessed a displacement of the metacarpal bone of the thumb from the trapezium, the former has been thrown inwards towards the metacarpal bone of the fore finger. The thumb has been bent backwards, and the extremity of the bone has formed a projection in the palm of the hand; it has been attended with considerable pain and tumefaction.

Reduction. In making the extension for reduction, it is particularly necessary to attend, as far as possible, to the relaxation of the most powerful muscles,

which are the flexors ; thus the thumb must, during the process, be inclined towards the palm of the hand. The force applied must be continued and steady, as violence will not effect the desired object.

If simple extension does not succeed in reducing the dislocation, the part must be left to the degree of recovery which nature will effect, as it would be improper to attempt relief by any division of muscles or tendons.

Compound dislocation. A compound dislocation may be produced at this articulation by the bursting of a gun, and in such a case, if the tendons are not lacerated, the dislocation should be reduced ; this can easily be effected, and, the edges of the external wound being brought together by suture, a good cure may, with careful treatment, be the result.

Case. A case of this kind occurred at Brentford, under the care of Mr. George Cooper, in a young gentleman, aged thirteen ; the injury was occasioned by the bursting of a powder-flask in his hand. The mass of muscle connecting the thumb to the hand was torn through, but the tendons of the long flexor, and of the extensors, were not injured. The dislocation was reduced, and the wound closed by sutures and adhesive plaster, over which an evaporating lotion was applied. The wound united in part rapidly, and the remaining portion healed kindly by granulation. Two weeks after the receipt of the injury, Mr. Cooper began the use of passive motion,

and the patient ultimately gained perfect motion in the joint.

^{Amputation required.} Should, however, the tendons be lacerated, or much surrounding mischief exist, amputation will be required ; and I have found it necessary, in such a case, to remove the articular surface of the trapezium, which I think may be done with advantage, especially when there is a scarcity of superficial soft parts.

c. Dislocation of the First Phalanx.

^{Simple.} In the simple dislocation at this articulation, the first phalanx is thrown back upon the metacarpal bone, forming a projection there, whilst the end of the metacarpal bone protrudes towards the palm of the hand ; the motions of the joint are destroyed, although the thumb can be made to approximate the fingers by the movements of the carpo-metacarpal articulation.

^{Reduction.} The mode of applying the extension for the reduction of this dislocation, should be as follows, and the direction should be towards the palm of the hand, to relax the flexor muscles. The hand should be soaked in warm water for a considerable time, to relax the soft parts as much as possible, then a piece of soft leather wetted, should be placed closely around the first phalanx, and over this a portion of tape, two or three yards in length, should be fixed by a clove hitch, (a knot, so called by

sailors.) An assistant should next firmly hold the metacarpal portion of the thumb, by passing his fore and middle finger between the patient's fore-finger and thumb, whilst the surgeon draws the first phalanx from the metacarpal bone, in a direction somewhat inwards to the palm of the hand.

Another method If the above plan does not succeed, the following should be adopted :—The leather and tape being applied as before, pass a strong worsted tape between the patient's fore-finger and thumb, and tie this to a bed-post, around which the arm should be bent; a pulley being then fixed to the tape connected to the first phalanx, a gradual and steady extension should be made, which will generally effect the reduction.

Sometimes not reduced When the above described means have been fairly tried, without success, it will be best to leave the case to nature, when the patient will, after some time, acquire a great degree of motion.

When compound. In cases of compound dislocation, should the reduction be difficult, a part of the extremity of the bone may be removed by amputation; and the patient may afterwards obtain a useful joint, by the early employment of passive motion.

d. Dislocation of the Second Phalanx.

Early detected. In a simple dislocation of this kind, the nature of the injury can scarcely be mistaken, and

the reduction may be accomplished in the following way:—The surgeon should grasp the back of the first phalanx with his fingers, and apply his thumb upon the fore part of the dislocated phalanx, and then flex it upon the first as much as possible.

Treatment of compound. The treatment of the compound dislocation of this articulation is the same as that recommended for a similar accident in the first phalanx; but the ends of the tendon should be made smooth by the knife, when, by careful approximation, they will unite. Passive motion may be used in two or three weeks.

FRACTURES.

INTRODUCTION.

FRACTURES IN GENERAL.

Definition. A SOLUTION of continuity of one or more bones, produced in general by external force; but occasionally by the powerful action of muscles, as is often exemplified in the broken patella.

Fractures constitute so interesting a branch of surgery, and the accidents themselves are so frequent and important, that the more scientific and successful views now entertained of the whole subject, than those prevalent forty or fifty years ago, must be highly gratifying to every admirer of the incessant progress of surgery towards perfection. Nor is this branch of surgery simply mechanical, or restricted to the consideration of bandages, splints, and other apparatus; but comprises questions and investigations not surpassed, in respect to their scientific character, by any others in the whole range of surgery.

By whom improvements have been effected. So long as the process by which broken bones unite was less correctly understood, and while the symptoms characteristic of each

particular fracture had been less minutely traced than at the present time, this department of practice must have been conducted under great disadvantages. The several complications of fracture are now more accurately comprehended, and more judiciously considered. Bandages are applied not for useless display, but to promote and fulfil some more desirable purpose; some indication, which the circumstances of the accident may truly require to be accomplished. The same may be said of all the mechanical contrivances employed in the treatment of fractures. For such improvements, and others to be noticed hereafter, the profession are indebted to the labours of Desault, Pott, Boyer, Dupuytren, Sir A. Cooper, and others, all eminently distinguished for their assiduity and research.

To the experiments and investigations of Duhamel, Breschet, Sanson, Cruveilhier, and Dupuytren, we are principally indebted for all the most valuable information yet extant relative to the formation of callus, a subject, however, which has not been neglected by British surgeons, as will be hereafter noticed. The perfection to which the mechanical aids have been brought, is owing likewise to the ingenuity of many individuals, especially Desault, Boyer, Assellini, Sir A. Cooper, Dupuytren, Amesbury, Earle, M'Intyre, and Greenhow.

Let it not be any longer supposed, that the treatment of fractures is only a mechanical process. Who-

ever pretends to be capable of conducting it efficiently, without a due acquaintance with anatomy and pathology, and the principles on which inflammation, abscesses, gangrene, wounds, ulcers, and erysipelas, haemorrhage, and various febrile disturbances of the constitution should be treated, must absolutely be a simpleton, or an impostor ; for all these complications frequently accompany or follow fracture. Under such circumstances, what man of common sense would trust his limb and life to a mere bone-setter ?

SECTION I.

DIFFERENT KINDS OF FRACTURES.

The varieties of fracture depend upon what bone is broken ; what portion of it is fractured ; the direction of the fracture ; the respective position of the fragments ; and, lastly, upon circumstances accompanying the injury, and making it simple, compound, or variously complicated.

a. Difference in respect to the bone broken.

Sometimes it is one of the broad bones, as the *scapula*, the *sternum*, or *ilium*. Sometimes it is a short bone, like the *os calcis*; but far more commonly, it is one of the long bones. The situation and functions of the *broad bones* render their fractures unfrequent. To this, however, the bones of

the *cranium* offer an exception, as they are often broken; but here the assistance of the surgeon is required less for the solution of continuity itself, than for the affection of the brain, and the extravasation with which the case is apt to be complicated. Fractures of the *short bones* are still more unusual, because these bones, being nearly equal in their three diameters, are capable of greater resistance, and are not much within the reach of external violence. Besides, most of them are but little exposed to the operation of outward force, by their situations or functions. Hence, except when limbs are crushed, fractures of short bones are generally caused by muscular action, which frequently breaks the patella, and sometimes the olecranon and os calcis. The *long bones*, which serve as pillars or arches of support for the body, or as levers for the actions of the muscles, are, by the nature of their office, particularly exposed to fractures. Their shape, use, and situation, are all so many circumstances rendering them extremely liable to be broken.

b. Differences in the part of the bone broken.

The long bones may be fractured at different points. Very often the *middle portion* is broken, and in this case they usually break like a stick which has been bent beyond its extensibility, by a force at each end of it. Sometimes the fracture occurs more or less near the *extremities* of the bone, which is

always an unfavourable event. Lastly, the bone is sometimes broken in several places, an injury which may be produced by two different causes operating successively or simultaneously, upon the broken parts of the bone ; or it may be occasioned by one single cause, which acts at the same moment upon several parts of it.

c. Differences in the direction of the fracture.

Fractures are either *transverse*, *oblique*, or *longitudinal*; peculiarities worthy of remembrance, because they have considerable influence over the difficulty or facility of effecting a cure. When a fracture is *transverse*, the resistance of the upper end of it will maintain the lower in its proper situation : but if it be *oblique*, the lower portion of the shaft of the bone will be much more easily displaced, and more difficult to keep reduced, than if the fracture were transverse. The reason of this fact is sufficiently obvious, for, in consequence of the obliquity of the surfaces of the fractures, the two ends of it are enabled to glide over each other, and the extensor and flexor muscles of the limb tend to draw the fractured ends of the bone towards their origin or more fixed point.

Duverney admitted another class of fractures, viz. *longitudinal*. Such cases were regarded by J. L. Petit as only imaginary, because he conceived that any blow capable of breaking a bone longitudinally,

would more readily cause a transverse fracture. For the same reason, Louis absolutely rejected the possibility of longitudinal fractures. The following case is related by Leveillé. An Austrian soldier was put under his care in the year 1800, in consequence of being struck by a ball in the lower third of the leg at the battle of Marengo; after receiving the injury, he walked to Pavia, a distance of several miles. In the end, amputation became necessary, and Leveillé preserved the tibia, upon which the impression of the ball was distinguishable. From this point proceeded several longitudinal and oblique lines, which extended from the lower third, towards the upper head of the tibia, and passed through the whole thickness of the parietes of the medullary canal. They were acknowledged to be really longitudinal fractures by Dubois, Chaufrier, Duméril, Deschamps, and Roux.

In several cases of fractured thigh bones from gunshot violence, which were under the care of Dr. Cole and Mr. S. Cooper, in Holland, the bone was fractured longitudinally to the extent of seven or eight inches. The fact, however, that bullets and other balls do produce longitudinal fractures, is now universally admitted; and were there any doubt upon the subject, a specimen sent to England by the late Dr. Cole would soon remove it.

d. Differences in the respective position of the fragments.

These differences are highly important, because the treatment essentially consists in obviating or preventing the displacement of the fragments. It is not to be supposed, however, that such displacement is a constant effect of all fractures, for it seldom takes place where there are two bones and only one of them is broken. Neither does it invariably happen in every fracture of the neck of a bone, as is exemplified in certain fractures of the neck of the thigh bone, the fragments of which sometimes change their relative situations only when the limb is too freely moved about. Fractures of the leg are also observed, in which there is neither a displacement of the fragments nor an alteration in the shape of the limb, especially when the tibia alone is fractured near its upper part, where it is very thick. When the ulna alone is broken at its upper part, there is hardly ever any displacement. The corresponding surfaces of the fragments, having a large extent, can only be separated with difficulty. Fractures of the fibula are also frequently unattended with any displacement. But when both bones of the leg or fore-arm are fractured together, there is generally more or less displacement; and such is also the case when a fracture occurs in the thigh, or upper arm, where there is only one bone. Here the little extent of the surfaces

of the fracture, and the great number of muscles, facilitate displacement.

The displacement may happen in respect to the diameter, length, direction, or circumference of the bone.

In diameter. In transverse fractures, this kind of displacement is frequently exemplified. The two fragments may either be in contact at a part of their surfaces or they may not be in contact at all. In the latter circumstance, the limb is shortened by the ends of the fracture slipping over each other.

In length. When the ends of the broken bone pass over each other, longitudinal displacement is produced, a form chiefly noticed in oblique fractures; sometimes it has been observed in transverse fractures, when the displacement, in the direction of the diameter of the bone, has been such that the surfaces of the fracture were no longer in contact. Whenever the limb is shortened, it is by displacement of the lower portion. The species of displacement that takes place in fractures of the patella, olecranon, and os calcis, may be referred to this class; but the fragments, in these cases, instead of passing over each other, recede in the direction of the axis of the bone, and continue separated by a more or less considerable interspace.

In the axis of the bone. In this kind of displacement, the two fragments where they meet form an angle, and the bone appears bent. This displacement is often termed

the angular deformity. It may occur in the leg, when the limb does not lie upon a surface exactly horizontal, and the heel is lower than the rest of the limb: the angular projection is then anterior. On the contrary, it would be posterior, if the heel were too much raised. It will also happen in fracture of the shaft of the thigh, if the lower part of the limb be too much depressed or elevated, or placed too much outwards or inwards.

In the circumference. Another kind of displacement is the *rotatory*, in which the lower end of the fractured bone is twisted inwards or outwards. Thus, in fractures of the neck of the thigh-bone, if the foot is badly supported by the apparatus, its weight, together with that of the limb, and the action of the muscles, inclines it outwards, and turns the lower fragment in the same direction.

Besides these displacements, there are others of a more complicated nature, which happen in several directions at once. For example, such is the displacement observed in a fracture of the thigh bone, when the lower fragment is drawn upward and inward, while the foot is turned outward.

Cause of displacement. Displacement in fracture may either be *immediate* or *secondary*. *Immediate* displacement is produced by the same violence as produced the fracture: thus, the wheel of a heavy carriage may pass over a person's leg, and break it, and at once produce a displacement of the broken ends of

the bone. A musket-ball may have the same effect. *Secondary* displacement may arise from two or three causes, the principal of which is the action of the muscles; but the weight of the limb will also be concerned in its production, if the injured part be not properly supported, or carefully carried. Thus, in a fracture of both bones of the leg, if the limb be laid upon its outer side, and the lower part of it be not duly supported, there will be an inclination of the inferior part of the tibia too much outwards.

Fractures are generally occasioned by falls; sometimes, however, the fall does not happen until after the limb is broken. The weight of the body then produces the displacement, by pushing the upper fragment against the soft parts, which are more or less lacerated. This happened to Ambrose Paré, who, being kicked by a horse, endeavoured to get out of the way, but instantly fell down, and the two bones of his left leg, which had been fractured, being impelled by the weight of the body, not only passed through the skin, but even through his stocking and boot.

Influence of the muscles in displacement. But, of all the causes of displacement, the action of the muscles is by far the most common, the most powerful, and the most difficult to counteract. Its usual effect is to draw the lower portion of the fractured bone upwards, or to make it, as the phrase is, *ride* over the upper fragment. The muscles principally concerned in causing

the displacement, are those whose insertions are below the fracture. Thus, when the humerus is fractured between its head and the insertion of the pectoralis major, this muscle, together with the latissimus dorsi and teres major, will draw the lower portion inwards. The fibres of the deltoid, it is true, may have some tendency to pull the upper fragment outwards ; but it is the muscles specified which have the greatest share in occasioning the displacement. The same principle enables us to understand why it is so troublesome to maintain the lower end of the fracture in its proper place, when the thigh is broken ; for the muscles of this part of the body are remarkably strong and numerous. Arising from the pelvis, which they make their fixed point, they are inserted into the femur below the fracture, and also into the patella and bones of the leg, which parts are their more moveable attachments ; consequently, in fractures of the leg, the gastrocnemius, the soleus, and the peronei muscles, all tend to draw the lower portions of the fractured bones to the outer and posterior side of the upper fragments.

Lastly, the muscles attached to the upper fragment may contribute to displacement. In a fracture of the thigh, immediately below the lesser trochanter, the psoas and iliac muscles carry forward the extremity of the upper fragment, which elevates the integuments, and forms a more or less considerable projection near the fold of the groin. But the dis-

placement of the upper fragment is generally less considerable and important than that of the lower.

e. Circumstances accompanying fractures.

Fractures, according to the circumstances which accompany them, are divided into *simple*, *compound*, and *complicated*.

Simple fractures. A *simple* fracture is so called, when there is no external wound communicating with, or extending down to, the broken part of the bone. A person may have a broken bone and a wound at the same time on the limb; still the fracture may be a simple one.

Compound fractures. A fracture is *compound* when attended with laceration of the integuments, which has been produced by the protrusion of one or both ends of the fracture through the skin, or by a ball or other body entering or otherwise wounding the soft parts, at the same moment that it breaks the bone.

Complicated fractures. Fractures are said to be *complicated*, when attended with diseases, or accidents, that render the indications in the treatment more numerous, and require the employment of different remedies, or the practice of sundry operations, for the accomplishment of a cure.

Thus, fractures may be *complicated* with severe degrees of contusion, wounds of the soft parts, injury of the blood-vessels, a dislocation, or diseases, and

particular states of the constitution, as the scurvy, rickets, syphilis, cancer, pregnancy, &c.

Communited fracture: When a bone is broken into several small fragments, it is said to be *communited*; in which case, or even where the bone is only broken in two or three places, the accident is much more serious than if it had only been broken at one part.

Bending of bones. Under the head of differences in fractures may fitly be introduced that injury to the bones of children which is denominated *a bending* of them, arising from falls, blows, and external violence, and requiring the same treatment as fractures, although crepitus and displacement of the fragments do not attend it.

SECTION II.

THE CAUSES OF FRACTURES.

The causes of fractures may be divided into *pre-disposing* and *remote*.

a. *Predisposing causes.*

Situations and functions of bones In the first class are comprehended the situations and functions of the bones, the age of the patients, and their diseases. Superficial bones are more easily fractured than those which are covered by a considerable quantity of soft parts. The functions of some bones render them more liable to be fractured than others; thus the radius which supports the hand is more liable to fracture than the

ulna. The clavicle, which serves to keep the shoulder in its proper position, and support on its arched extremity all the motions of the upper limb, is particularly liable to fracture.

Different ages. Fractures may occur at all ages ; but, as the texture of the bone varies at different periods of our existence, some differences in their liability to fracture will be created by this circumstance. The quantity of earthy matter in the bones of children is comparatively small ; but as man advances in years, the proportion of this ingredient increases, while that of the animal matter diminishes ; the consequence is, that they are rendered considerably more brittle than in the early periods of life.

In infancy. In children, the large proportion of animal matter in the bones communicates to them a degree of elasticity and flexibility far exceeding what is noticed in the bones of older subjects. In children, the bones are also much protected by a quantity of adipose substance, and the muscles are not yet sufficiently developed to act violently upon them. The bones of children ought, therefore, to be rarely broken ; but their venturesome tricks and carelessness in some measure counterbalance these advantages, and explain the reason why the fractures of particular bones are tolerably frequent in the early periods of life. The bones of children, in bending, sometimes break only in the convexity of the curve ; a peculiarity restricted to the early periods of life.

In adults. In adults, in whom the texture of the bones is actually strongest, one might expect a corresponding diminution of the frequency of these accidents; but the protection of firmness of texture is counterbalanced by the many dangerous employments in which a large class of society is engaged, during the long interval between infancy and old age. In full manhood, too, the muscular system has acquired its greatest force, and hence fractures of the bones of adults are very common indeed.

From disease. Lues venerea, cancer, rickets, and scrofula, predispose to fractures. In the museum of University College, London, are two thigh bones, taken from a patient who was using mercury for the cure of syphilis; one has several nodes upon it; the other broke as he was turning himself in bed. In the advanced stages of cancer, the bones are also frequently broken by the slightest force or pressure, or the common and even very weak action of the muscles. In the museum of St. Thomas's Hospital, there are or used to be two thigh bones, which were broken in consequence of the weakening of their texture by the effect of cancer; in the sternum of one of the patients from whom they were taken, is a proportion of scirrhouous matter, occupying the place of the earthy matter which has been absorbed. Desault mentions the case of a nun in the Salpêtrière, whose arm was broken, as a person was handing her out of a carriage. Louis, who was vexed that no union took

place, was not a little surprised to find her thigh bone experience the same fate one day as she was changing her posture in bed. It was then learned that she had a cancer in her right breast. All pathologists know, that this effect of cancerous diseases in the body on various parts of the skeleton, is not an uncommon occurrence. Rickets, fragilitas, and molilitus os-sium, scurvy, serosula, fungus haematodes, and certain diseases within the cancellated texture of the bone, are all well known to communicate a predisposition to fractures: it is therefore unnecessary to particularize. Tumours have also been known to predispose to fractures, by pressure on the bones, leading to absorption of the osscous texture.

b. Remote causes of fractures.

The remote causes of fractures are, first, external violence acting directly upon the part broken; secondly, external violence applied to parts more or less remote from the seat of fracture; and thirdly, the action of the muscles, as in ordinary fractures of the patella.

External violence. When a person alights on the ground from a great height, and fractures his thigh or leg, the resistance of the ground and the weight of the trunk produce the fracture; there is no violence applied directly to the broken part, but the extremities of the bone receive the force, and the middle portion bends and breaks. This case is very different from

one in which a man's leg is broken by the kick of a horse; here the violence is applied directly to the part which is fractured.

Muscular action. In particular instances, the bones are broken by the violent action of the muscles attached to them. This is almost always the case in fracture of the patella. It has, indeed, been asserted, that the action of the muscles is invariably concerned in the production of fractures; but this doctrine certainly goes beyond the bounds of accuracy. True it is, that when a person falls down, he endeavours to save himself, and for this purpose puts his muscles into violent action, which may therefore be supposed to have some share in producing certain fractures; yet, that muscular action is *always* concerned in producing fracture, must be an incorrect hypothesis.

The position, that the long bones can be fractured by muscular action alone, has long been disputed. Various cases have been recorded by continental and English surgeons in proof of the fact: Mr. S. Cooper mentions the case of a Mr. Ramsden, an exceedingly strong man, who broke his os humeri in making a powerful blow, although he missed his aim, and struck at vacancy. The whole of the limb was afterwards affected with vast swelling and inflammation.

SECTION III.

THE SYMPTOMS OF FRACTURES.

Some of the signs are equivalent.

Some of the symptoms of fractures are equivocal : the pain and inability to move the limb, commonly enumerated, may arise from a mere bruise, dislocation, or other cause. The crepitus ; the separation and inequalities of the ends of the fracture, when the bone is superficial ; the change in the form of the limb ; and the shortening of it ; are circumstances communicating the most certain information ; and the crepitus in particular is the principal symptom to be depended upon, although occasionally attendant upon dislocations, and arising from a change in the quality of the synovia, as already mentioned. (Page 6.) The signs of fractures, however, are so exceedingly various, according to the bones which are the subject of injury, that it cannot be said, there is any one which is invariably present and characteristically confined to them. The writers of systems of surgery usually notice loss of motion in the injured limb, deformity, swelling, tension, pain, &c., as forming the general diagnosis of fractures. Now, it is easily comprehensible, by any one acquainted with anatomy, that numerous fractures cannot prevent the motion of the part, nor occasion outward deformity ; and every surgeon

must know, that although, at first, there may be pain in the situation of the fracture, no inflammation, swelling, and tension can take place till after a certain period. There may, however, be swelling produced in the first instance by extravasation of blood, or by displacement of the ends of the bone.

When, therefore, a bone is broken, and the accident is not manifest from the distortion of the part, it is proper to trace with the fingers, the outlines of the suspected bone : if it be the tibia, let the surgeon with his fingers try whether any inequality can be discovered along the anterior surface, and along the sharp front edge of that bone. If it be the clavicle, let him trace the superficial course of the bone in the same attentive manner.

Crepitus Of all the symptoms of fracture, no symptom is more important, or affords a better proof of the nature of the injury, than the *crepitus*, or grating noise or sensation, occasioned when one end of the broken bone is moved upon the other. This grating or crepitus may usually be perceived, on pressing upon or trying to bend the bone itself, or on bending, extending, or rotating the nearest joint. It should, however, be known, that the absence of crepitus is no proof that a fracture may not exist ; for, when a fracture has existed some days, the ends of the bone become smooth, and there will consequently be no crepitus or grating. The two ends of a broken

bone may also be so much displaced as not to be in contact, and then, of course, no crepitus can happen. On other occasions, a portion of the soft parts may be interposed between the fragments, as, for instance, a portion of muscle ; and here, likewise, no crepitus will be felt on moving the part ; but whenever the grating noise or sensation can be distinguished, it is one of the surest signs of the existence of a fracture.

Detection of crepitus by the stethoscope In some cases, the broken bone is so surrounded with thick fleshy parts, that it is difficult to feel a crepitus, or ascertain the existence of the injury. Some fractures of the neck of the thigh bone are cases illustrative of this observation. In very doubtful cases, the stethoscope has been proposed as a means of elucidating the diagnosis, and Lisfranc is said to have used it with success.

Considerable harm, and great unnecessary pain, have been occasioned by too much solicitude to feel the grating of fractured bones ; and whenever the case is sufficiently evident to the eyes, the practitioner who gives way to this habit, at the expense of torture to the unhappy patient, ought, in my opinion, to be severely censured. A fracture is an injury necessarily attended with a great deal of pain, and followed by more or less swelling and inflammation ; to increase these evils, by roughly or unnecessarily handling the part, is ignorant and cruel, and (if I may use the expression) unsurgical.

Loss of the use
of the limb.

One symptom of a fracture is the loss of the use of the limb or part: this is, no doubt, a common effect of most fractures, the functions of the limb or part being more or less impeded; but no positive conclusion can be drawn from this circumstance, because it is one that accompanies other injuries and diseases, and does not invariably attend a fracture. When the portion of the limb, in which the fracture takes place, has only one bone on which its inflexibility and firmness depend, then the loss of its use will immediately follow the fracture. Thus, when the humerus or femur is broken, the patient immediately loses the power of using the limb; but if only one bone happens to be broken in a part of a limb in which there are two bones, the patient may then retain some use of the limb. For instance, if the ulna alone be broken, considerable power of using the hand and fore-arm will remain; but if both the radius and ulna be broken, then the circumstances will be different, and the functions of the part will be more or less completely interrupted. Sometimes, even when there is only one bone in a limb, and that is broken, a degree of power of employing the limb will be retained, that is to say, the use of it will not be so entirely destroyed as to render the nature of the case at once evident. Thus, in a fracture of the neck of the thigh bone, if one fragment be wedged and entangled in the other, there will be no separation of them, nor any retrac-

tion of the limb; and patients in this state have actually been able to walk some distance after the accident. This circumstance might cause the real nature of the injury to remain unsuspected; but it is very rare. When the injured part of a limb contains two long bones, and only one of them is broken, the other supports the fractured one and generally prevents retraction, or much displacement of the lower fragment; in fact, the perfect bone acts as a splint in keeping the broken bone steady, and hindering deformity; and, under these circumstances, great attention may be requisite to detect the nature of the accident.

Shortening of the limb. When the injured limb is shortened, the surgeon, before pronouncing that such change proceeds from the passage of the fragments over each other, must be sure that the bones are not dislocated, or that the limb is not naturally shorter than the other, in consequence of a previous fracture that has been badly set. In comparing the length of the lower extremities one should place the pelvis in a horizontal position, and put the two anterior superior spinous processes of the ossa ilium in the same line: for, if these processes are not on a level, the limb towards which the pelvis inclines, will seem longer than its fellow.

SECTION IV.

PROGNOSIS OF FRACTURES.

The prognosis of fractures varies, according to the kind of bone injured,—what part of it is broken,—the direction of the breach of continuity,—and what other mischief complicates the case.

^{The kind of} _{bone injured.} Those broken bones which have the greatest number of muscles attached to them are usually the most difficult to repair without deformity; because the muscles are the principal cause of the ends of the fracture being displaced; and when the muscles are numerous, or particularly strong, more difficulty will be experienced in counteracting their influence.

^{According to} _{the part of the bone broken.} A fracture of the middle part of a long bone is less dangerous than a similar injury near one of the joints, which may be followed by synovial inflammation and ankylosis. Thus, in a fracture of the thigh bone, near the condyles, the inflammation and swelling extend to the knee joint, which is affected with a degree of stiffness that continues for a long while, and sometimes cannot be entirely cured during life. The experiments of M. Cruveilhier prove, that various forms of irritation will make the periosteum, ligaments, and cartilages ossify; and it has been ascertained, that in some cases of fractures near the joints, the ligaments have

sometimes been converted into bone. Inflammation of a joint, brought on by fracture, is attended with more severe symptoms, in proportion as the contusion has been more violent. In a fracture near an articulation, it is to be observed, also, that common splints have little command over the short fragment, so that it is often difficult with them to prevent displacement; and with respect to transverse fractures of the neck of the thigh bone within the *capsular ligament*, although the possibility of bony reunion in such cases is no longer disputed, the cure is more commonly effected by means of a fibrous ligamentous substance.

According to the direction of the fracture. *Oblique* fractures are more difficult of cure, and more troublesome in their management than *transverse* ones; because an oblique surface does not resist the retraction of the lower portion of the broken bone, and consequently the ends of the fracture are kept duly applied to each other with difficulty; consequently the risk of deformity is greater. *Longitudinal* fractures of the cylindrical bones are generally severe cases, because they rarely occur, except from the effects of gun-shot wounds, and are liable to extend into joints.

According to the injuries which attend it. Fractures, complicated with contusions or wounds of the soft parts, rendering them *compound* fractures, are more dangerous than *simple* fractures. The bad symptoms which render compound fractures so dangerous are of many kinds:

hemorrhage ; violent and extensive inflammation of the limb, either phlegmonous or erysipelatous ; delirium and fever ; large abscesses ; gangrene, &c. Ankylosis is a frequent, though not invariable, occurrence after compound fractures in the neighbourhood of joints. Fractures occurring to old people, or persons of feeble or debilitated constitutions, are less favourable than when they occur in young and vigorous persons. Predisposition to disease, particularly erysipelas, is an obstacle to the successful treatment of fractures. The presence of those diseases which predispose to fracture will also necessarily interfere with the treatment. Pregnancy has been considered by some, as unfavourable to the union of fractures ; this, however, is denied by several continental and English surgeons, and is pretty generally discredited.

SECTION V.

TREATMENT OF FRACTURES.

In the treatment of fractures, three grand or general indications are necessary. The first is to reduce the pieces of bone into their natural position. The second is to secure and keep them in this state. And the third is to prevent any unpleasant symptoms which are likely to arise, and relieve them, if they come on.

a. Reduction of fractures.

The means employed for the reduction of fractures

in general, are chiefly three, viz., *Extension*, *counter-extension*, and *coaptation* or setting. But, as Boyer remarks, these means should vary according to the species of displacement; and surgical writers have generalized too much in representing all three as necessary for the reduction of every kind of fracture. There are many cases in which extension and counter-extension are positively useless: of this nature are fractures of the patella and olecranon, where the displacement consists of a separation of the fragments. Here the reduction may be accomplished, by putting the limb in a position in which the muscles attached to the upper part of the bone are relaxed, and then pushing the upper fragment into contact with the lower one.

Extension and counter - exten-
sion. Extension signifies the act of pulling the broken bone in a direction from the trunk, with the view of bringing the ends of the fracture into their natural position. By counter-extension, surgeons imply the act of making extension in the opposite direction, in order to hinder the limb, or even the whole body from being drawn along by the extending power, which would then be unavailing.

It was formerly recommended to apply the extending force to the lower fragment, and the counter-extension to the upper one. Such practice was, indeed, advised by Mr. Pott, and is still generally preferred in this country; but upon the continent it has been

abandoned. The objections made to it by Boyer are, first, that it is frequently difficult, and sometimes impossible, to take hold of the two fragments; as, for example, when the neck of the thigh bone is broken. Secondly, that by applying the extension and counter-extension to the broken bone itself, most of the muscles which surround it are compressed; and such compression produces in these organs a spasmodic contraction, which often renders extension and counter-extension useless, and sometimes even hurtful. The French surgeons, therefore, apply the extending force to that part of the limb which is articulated with the lower fragment, and the counter-extension to that which is articulated with the upper. For instance, in a fracture of the leg, the extending means act upon the foot, and the counter-extending upon the thigh; and in a fracture of the thigh, the extension is applied to the leg, while the counter-extending power fixes the pelvis.

Muscular resist-
ance to be over-
come. Modern experience teaches us, that not one quarter of the force is necessary for the purpose of reducing broken bones, that was formerly resorted to; because surgeons of the present day avail themselves of the advantages, derived from the relaxation of those muscles which have the power of displacing the fragments. Thus, in a fracture of the bones of the leg, the powerful muscles of the calf are relaxed by bending the knee, by which means the displacement may be obviated with little

difficulty, and with the employment of less force than would otherwise be necessary. The same thing is illustrated in the case of a broken thigh; but here the exact position, which, in Mr. Pott's opinion, has the greatest effect in relaxing the principal muscles capable of disturbing the fracture, is unfortunately not that in which the most effectual mechanical means for maintaining the reduction can be employed. The principle of relaxing the muscles, therefore, should not completely preponderate over all other influential considerations. On the contrary, I am convinced, with Desault, that, in general, what is gained by the relaxation of some muscles, is lost by the tension of others. But where it is possible to relax, by a certain posture, the set of muscles most capable of preventing reduction, and disturbing the coaptation of the fracture, that posture I would select.

Impropriety of violence in the reduction.

When extension and counter-extension are practised to obviate the retraction or shortening of the limb, no unnecessary force should be exerted; the bone should be pulled steadily and gently in the natural direction of its axis, until it resumes its proper length, and then the two ends of the fracture are to be adjusted, or, in technical language, coaptation is to be performed. In certain cases, a good deal of trouble arises from continual spasms of the muscles; and, if the patients be strong and athletic, it will be advantageous to bleed them

freely, and put them under the influence of opium, morphia, or hyoscyamus, when the reduction will be more easily accomplished and maintained.

b. Means for keeping fractures reduced.

After the ends of the bone have been put into their natural position, time alone would produce union, were there not, in the muscles, a continual tendency to displace the ends of the fracture again. In cases of fracture, the muscles are often affected with involuntary spasmotic action, by which the broken part would certainly be displaced, were no measures taken to maintain the extremities of the broken bone in contact. *It is necessary, therefore, to keep the ends of the fractured bone steadily in contact, so that nature may have a favourable opportunity of uniting them.* This indication is so plain as hardly to require explanation: the ends of the fracture must be kept motionless; for, if this rule were neglected, they would not be united by osseous matter, but an artificial joint would be produced by the ends of the fracture becoming smooth, and being joined together by a fibrous ligamentous substance. The means employed for the fulfilment of this indication, are,—an advantageous position;—quietude;—bandages;—splints, and various kinds of apparatus.

Position. In the treatment of all fractures, the position of the part, and indeed of the whole body, is fractures of the

lower extremities, the patient should lie strictly in bed, until the callus is completely formed and strong. Common beds, intended for the reception of patients with fractures, should not be too wide, because the surgeon and assistants can then more conveniently get at any part of the limb; nor should they be feather beds, which soon sink in the centre, and not only have an unfavourable effect on the patient's posture, but render his condition very uncomfortable: hard, unyielding horse-hair mattresses are preferable. Boyer, indeed, was so impressed with the utility of letting the patient lie upon a surface which will not sink, that he recommends two mattresses to be used, and a board to be laid under the upper one, from the hip to beyond the patient's foot.

Fracture beds. When, however, the patient is likely to be confined for a long time, with a severe simple, or compound fracture, it is advisable to employ beds expressly adapted to such cases, as they enable the patient to obey the calls of nature without any disturbance of his body or limbs. And indeed fracture beds are brought to such perfection, that they not only can be converted into a double oblique plane, for the ease of the fractured limb, but also allow the head and chest to be raised or lowered without the slightest disturbance of the fracture, or any effort of the patient himself, who may even be inclined to either side, if such posture be required, in an equally quiet manner. Fracture beds afford, indeed, great

comfort to patients who are likely to be long confined by bad fractures either of the limbs, spine, or pelvis.

Generally, the most favourable position for a fractured limb is that, in which all the muscles, passing over the fracture, and extending either to the lower fragment, or to that part of the limb which is articulated with it, are equally relaxed. The injured limb should also have firm support at every point, and its position ought to be so regulated, that not only this object may be carefully fulfilled, but, at the same time, the chance of displacement from the action of the muscles, or the weight of the body or part itself, may be diminished as much as possible.

The natural, or rather the most easy, position of the limb is that which is usually chosen by a person who reposes himself, or who is sleeping; for then all motion is suspended, and every part assumes that posture which is most agreeable to it. In this condition, the limbs are not extended, nor yet entirely bent; but only in a moderate state of flexion. Hence Boyer very properly remarks, that a half bent position of the limb is that in which all the muscles enjoy an equal degree of relaxation, and, consequently, that it is, generally speaking, the best for fractures. This posture, which was recommended by Hippocrates and Galen, has been highly extolled by Pott, who appears to have exaggerated its advantages. Considered in a general way it is, without doubt, preferable to

every other position of the limb, but its employment should be liable to exceptions, as will be noticed in treating of particular fractures.

Quietude. In whatever position fractured limbs are placed, they ought to be kept perfectly quiet, during the whole time requisite for the union. If the broken bone be moved while the callus is forming, the surfaces of the fracture rub against each other, and the process is disturbed and retarded; and indeed, by repeatedly moving the limb, the consolidation of fractures is sometimes entirely prevented. In order to maintain the limb in the right position, and in a state of perfect rest, so as to preserve the fragments in proper contact with respect to each other, the surgeon should caution his patient to avoid moving more than can be helped, and every cause likely to subject the limb to any kind of shock or concussion ought to be removed. But in particular, it will be necessary to apply a retentive apparatus consisting, generally, of long thin portions of wood, tin, or pasteboard, termed *splints*; together with pads, compresses, cushions, and bandages.

Splints. “Splints,” says Pott, “are generally made of pasteboard, wood, or some resisting kind of stuff, and are ordered to be applied lengthways on the broken limb; in some cases three, in others four; for the more steady detention of the fracture. Splints, properly made, and judiciously applied, are, without

doubt, highly serviceable ; but their utility depends much on their size, and the manner in which they are applied.

“ The time and proper use of splints is to preserve steadiness in the whole limb, without compressing the fracture at all. By the former they become very assistant to the curative intention ; by the latter they are very capable of causing pain and other inconvenience ; at the same time that they cannot, in the nature of things, contribute to the steadiness of the limb.

“ In order to be of any real use at all, splints should, in the case of a broken leg, reach above the knee and below the ankle ; should be only two in number, and so guarded with tow, rag, or cotton, that they should press only on the joints, and not at all on the fracture. By this they become really serviceable ; but a short splint, which extends only a little above and a little below the fracture, and does not take in the two joints, is an absurdity, and what is worse, it is a mischievous absurdity. By pressing on both joints, they keep not only them, but the foot steady ; by pressing on the fracture only, they cannot retain it in its place, if the foot be in the smallest degree displaced ; but they may, and frequently do, occasion mischief, by rudely pressing the parts covering the fracture against the edges and inequalities of it.

“ In the case of a fractured os femoris, if the limb be laid in an extended posture, one splint should

certainly reach from the hip to the outer ankle, and another, somewhat shorter, should extend from the groin to the inner ankle. In the case of a broken tibia and fibula, there never can be occasion for more than two splints; one of which should extend from above the knee to below the ankle on one side, and the other splint should do the same on other side." (Pott's Chir. Works, vol. 1, p. 298, &c. Edit. 1808.)

Ruds, &c. As splints are generally composed of hard materials, the bad effects of their pressure upon the skin must always be counteracted by placing a sufficient quantity of tow, wool, oaten chaff, bran, or other soft substances, between them and the limb.

Splints not always necessary. Sometimes almost every thing is effected by the relaxation of certain muscles, or by position, without splints, which could not act, either directly or effectually, on the fracture. For instance, in fractures about the shoulder, affecting the scapula or clavicle, the treatment is conducted altogether without splints. Then again, in certain other cases, splints are indeed used, not as a temporary substitute for bone, nor as a means of giving support and steadiness to the part for a time, but for the sake of keeping the limb in a particular position. Thus, in fractures of the neck of the thigh bone, splints are used, not to support that particular part of the bone, but to maintain the limb in a determinate position. In fractures of the patella and olecranon, the same fact is illustrated; in these cases, splints are not employed on the

principle of affording lateral support, as in a common fracture of the thigh or leg; but to retain the limb in a particular position. Here splints could have no direct action on the fractured part.

The sling. The sling is another contrivance of great service, especially in fractures of the upper extremity; for it not only supports the limb in the most desirable position, but keeps it as quiet as the leg would be, by confining the patient in bed. In other words, a sling is as useful for fractures of the upper extremity, as the recumbent posture is for fractures of the leg or thigh; with this additional advantage, that, as the patient is not confined to bed, he can take exercise, and his health is less likely to suffer. The sling should never be omitted, when the clavicle, scapula, humerus, bones of the fore-arm, or those of the metacarpus and fingers, are broken.

Bandages. With respect to bandages, the common roller answers for fractures of the humerus, radius, ulna, and fibula. Indeed, when M'Intyre's apparatus is made use of, or Desault's method of treating a broken thigh is followed, it is the most eligible bandage for all simple fractures of the lower extremity, and even for some compound ones. But if a broken thigh or leg is to be treated according to Pott's directions, the eighteen or many-tailed bandage is necessary; by using which, all necessity for lifting up and disturbing the limb every time it is dressed, or every time the bandage loosens, is avoided. Indeed, when it is used,

the leg or thigh need never once be removed, during the cure, from the pillow or splint on which it has been deposited.

It has been customary, at St. Bartholomew's Hospital, ever since the time of Pott, to apply a plaster of brown soap cerate to the integuments over a simple fracture, and many surgeons still follow this plan. Pott says, that "if this plaster be employed, it should be put on in such a manner as that it may be renewed and shifted as often as may be necessary, without moving the limb in any manner: it being certain, that when once a broken thigh or leg has been properly put to rights, and has been deposited properly on the pillow, it ought on no account to be lifted up or moved from it again, except from urgent necessity, until the fracture is perfectly united."

Baron Larrey's stiffened bandages. So convinced is Baron Larrey of the advantage of keeping broken limbs perfectly motionless, after they have been properly set, that he sometimes employs an apparatus, which moulds itself to the shape of the limb, then hardens, and remains applied during the whole of the treatment, unless circumstances call for its earlier removal. The apparatus is made by wetting the pads, compresses, and bandages in a lotion, containing the acetate of lead and white of egg; which, when it has dried, leaves the apparatus sufficiently hard and stiff to afford full support and steadiness to the limb, with the advantage of being most perfectly accommodated to the ex-

terior of it. This plan is followed not only in simple, but also in compound fractures; and, where there is a necessity for removing the patient any distance, is found by Larrey to be highly expedient.

Assalini's objections to bandages. Assalini strongly objects to all bandages and the plan of covering the whole of the broken limb with splints. He was called to a gentleman of rank at Paris, who had broken the patella transversely. He laid the limb upon a concave splint, the shape of which was adapted to the under surface of a part of the leg and thigh. No bandage was used, merely two leather straps, which crossed upon the knee, and included the fractured bone. A perfect bony union was thus easily effected. Assalini afterwards extended the use of a concave splint, applied under the limb, to fractures of the leg and thigh. In the first of these cases, however, only the thigh is received into the hollow splint, and from this two lateral splints go along the leg. The apparatus has also a kind of sole for the support of the foot. As this simple contrivance is fastened with very few straps, and no plasters or bandages are used, the surgeon has a command of the whole front of the limb, and of the fractured part in particular. In compound fractures, he covers the wound with linen compresses wet with cold water.

Treatment by permanent extension. In certain oblique fractures, where the ordinary means of treatment will not procure union free from deformity and shortening of the

limb, it has been proposed to employ *permanent extension* during the process of union. By this is meant, any contrivance or machine, which, drawing the fragments continually in opposite directions, restrains them from gliding over each other, and maintains them in contact during the whole time necessary for their union. In England this plan has given place to the treatment of fractures by muscular relaxation. Desault, conceiving the perfect relaxation of all the muscles to be unattainable, never ceased to inculcate the employment of permanent extension to prevent the shortening of the limbs. And when we consider the treatment of fractured thighs, we shall see, that the principle of permanent but moderate extension has had advocates of great talent and eminence in France, though it has been strongly objected to by many surgeons in this country.

Boyer considers, that by means of permanent extension, we not only succeed in uniting fractures, while the natural length of the limb is preserved, but also afford a steadiness which is singularly favourable to the formation of callus; and, in the application of this principle, he recommends the observance of the following rules.—1st. Avoid compressing the muscles which pass over the situation of the fracture, the elongation of which is necessary to restore the limb to that length which it had lost by the fractured extremities gliding over each other.—2dly. The extending and counter-extending force ought to be di-

vided upon as large a surface as possible.—3dly. The powers making permanent extension should act according to the direction of the axis of the broken bone.—4thly. The extension should be practised in as gradual, slow, and insensible a manner as possible.—Lastly: the parts upon which the extending and counter-extending forces act should be defended, and the compression made by the tapes, or other pieces of bandage or apparatus, ought to be equalised.

c. Means for preventing and removing unfavourable symptoms.

Having reduced the fracture, and adopted means for securing the parts in an advantageous position, our next object should be to prevent (if possible) any unfavourable symptoms from arising, or to remove them if they have already appeared. There may, for example, be an unusual degree of pain from various causes, swelling from effused blood, a severe degree of inflammation, *crysipelas*, the formation of abscesses, &c. Any, or all of which circumstances may follow the setting of a fractured limb.

Prevention of inflammation. With the exception of a few simple fractures of the upper extremity, it is proper to allow, for the first few days, only very low diet; this, however, should not be continued longer, unless great inflammation arise, for experience proves, that when ~~too much prolonged it has a bad effect, and tends to~~

retard the union of the fracture. For preventing inflammation, quietude is undoubtedly one of the principal means; but while quietude is enforced, other means should not be neglected. Venesection, for instance, is sometimes necessary, when the accident is attended with much contusion of the soft parts; a description of mischief which is generally greatest when the fracture has been produced by direct violence, as a blow or a kick.

Constipation. Constipation should be obviated by the use of mild aperients; but as fractures of the lower extremity are liable to a hurtful degree of disturbance from frequent purging, this practice must be adopted with extreme caution. In such cases it is desirable to have the means of evacuating the rectum, without disturbing the fracture. This is accomplished in various fracture beds, where the fæces can be voided, without the slightest change of position, by means of a kind of trap, which, opening under the bed, admits of the withdrawal of a portion of the mattress, a tin receptacle is then placed there for the purpose of receiving what is voided by the bladder or rectum.

Topical applications. Leeches and cold lotions are the best topical remedies for inflammation in the early stages of fracture; after a time, if there be any disposition to the formation of abscesses, fomentations and even poultices may be applied; but leeches and cold lotions are preferable to these, in the commencement of the

case. The best way of using cold lotions will be to squeeze them out of a sponge upon the bandages or linen surrounding the limbs, so that the fluid may pass between the splints, and wet the bandage or linen without removing the splints. Carefully avoid all plasters and ointments that irritate the skin or create a disagreeable itching, for they sometimes bring on erysipelas. The emplastrum saponis in common use is the best in all simple fractures, rather because it does no harm, than because it does any essential good.

^{Spasm in the limb.} In fractures of the lower extremity, particularly the leg, it sometimes happens that the limb is affected with spasms, which displace the ends of the bone, for the first two or three nights after the reduction. If the patient be young and strong, let blood be taken from the arm, the bowels be emptied, and opium or morphia prescribed; strict attention being also paid to restore the ends of the fracture to a right position again. If they cannot be kept in a good posture at first, they will admit of being so after a few days, when the tendency to spasm has diminished.

^{Weakness and stiffness of the limb.} All fractures, however simple and well treated they may be, are constantly followed by weakness and stiffness of the limb. These unpleasant consequences are greater, the more violently the limb has been confused, the nearer the

mained motionless and without exercise. The stiffness always affects the inferior joint of the broken bone much more than the superior. For the relief of these effects of fractures it is customary to employ friction, liniments, emollient applications, cold washes, and bathing; sometimes, notwithstanding such remedies, the limb does not quickly recover its strength, but remains stiff and weak for a year or more. The most effectual plan for the prevention of this state should therefore be resorted to early. These consist in making the joints nearest the fracture execute slight motions, as soon as the union is sufficiently advanced not to be in danger of interruption from this practice. A great deal of caution, however, is necessary in moving the part, and it is safer for the surgeon to superintend the business himself, than leave it to the patient or others. One of the best proceedings also for the hinderance of much weakness and stiffness in the limb after a fracture, is to discontinue the splints and tight bandages immediately the state of the callus will allow. The manner in which their pressure retards the circulation and prevents the action of the muscles, is one of the principal causes of the stiffness of the limbs; consequently, the sooner they can be safely left off, the sooner will the patient regain the free use of the limb.

SECTION VI.

COMPOUND FRACTURES.

Definition. A *compound fracture* is that in which there is an external wound communicating with the broken extremities of the bone. Large wounds may occur at the same time with fractures, but unless these communicate with the bone they are not called compound fractures. The immediate result of the fracture is the escape of the extravasated blood, which in simple fracture becomes absorbed. The effect this injury produces on the constitution is to set up a violent re-action, and so bring about a restoration of the injured part. The degree of this effort of the system will very much depend on the manner in which the accident is treated; and I should say, that it was an important injury, or otherwise, according to the plan of treatment which is pursued. For if care be taken in the management of the case, adhesion of the external wound may occur, and the accident be reduced to the state of a simple fracture.

Mode of union. The mode of union is ultimately the same; but, in one kind of injury, ossific matter is deposited in cartilage *without* a suppurative process, and in the other, *with* it. If we do not procure an union by adhesion, it is brought about by granulation, and in the following way.—^{TL.}

at first poured out in consequence of the division of the vessels of the medullary membrane and the periosteum, instead of being confined in the surrounding structures, passes off by the external wound ; it must be remembered, however, that this effused blood has no share in producing union of the ends of the bone, as it becomes, after a few days, entirely absorbed. Next, a fluid is poured out between the periosteum and the bone, which separates the periosteum from the surface of the bone for about an inch or an inch and a half beyond the place where the bone is fractured. This fluid does not cause a laceration of the vessels of the periosteum, but rather an elongation of them. Here, then, is the difference between simple and compound fracture ;—in the former, the fluid, after accumulating for a day or two, becomes in a great measure taken up by the absorbents, and adhesive matter is poured out in its stead ; while, in the latter, a suppurative process is established, and granulations arise from the broken surfaces. Cartilage becomes deposited in these granulations, and continues to be formed for some time ; the discharge of pus gradually diminishes, and, in compound fracture, cartilage continues to be formed until about the twentieth day. It is deposited between the internal surface of the periosteum and the external surface of the bone. Where the bones are brought into contact, the periosteum becomes absorbed, and cartilage

is deposited between them; in which patches of bony matter are formed, and these, when completed, are covered by an extension of the original periosteum.

The cause of non-union. The cause of non-union in fractures is to be found in the want of approximation; for, if the fractured ends are not brought into contact, the periosteum is not raised, the cartilage that forms does not cover the extremities of the bones, and the protruding portions are removed by the absorbents; so that the process of union only goes on in those surfaces of bone which are lying in contact.

Period required for ossification. Cartilage is also found under the granulations arising from the cancellated structure; and bony patches are deposited in the cartilage about the twelfth day in simple, and from the seventeenth to the twentieth day in compound fractures. By the accumulation of these patches, ossific union gradually takes place. A compound fracture is necessarily slower in its progress towards recovery, from the causes just explained, than a simple fracture; and the union is frequently retarded by exfoliations of bone, which will often take up a tedious time to separate, and keep up considerable constitutional irritation. *Three months* may be considered a short period for the union of a compound fracture to take place; sometimes the accident is not recovered from in nine months.

Treatment under common circumstances.

I shall now proceed to speak of their treatment under common circumstances.

Reduce the bones as speedily as possible; this may very easily be done by relaxing the muscles acting upon the limb. Bring them as nearly into apposition as possible, and, if there be slight haemorrhage, do not lose time by searching for a small vessel, but place a little lint over the wound, and, by making gentle pressure on it, the haemorrhage is easily suppressed. I have some further remarks to make on this subject, which I shall introduce when speaking of the difficulties that sometimes attend these accidents. Next bring the integuments as neatly over the parts as you can, dip a dossil of lint in the blood, and put it on the surface of the wound. This irritates less than any application I know of, and appears to approach the nearest of any other to the natural covering of the parts. In this way the wound unites by the adhesive process, the union of the bone goes on as in simple fracture, and is cured in one fourth part of the time which would be required if the wound were allowed to be filled by granulations. This, then, is the principal object you should always aim at, unless the fracture be accompanied with severe contusion of the soft parts; when it will be necessary to apply a poultice, in order to facilitate the discharge from the wound, and promote the separation of the part to be removed. For example,

in a wound caused by a heavy body passing over the limb, the parts must slough, and therefore it would be useless to attempt to procure an union by adhesion. If the wound communicating with the fracture be caused by the ends of the bone or any sharp instrument, we may generally succeed in procuring adhesion. Do not apply adhesive plaster, as it frequently produces erysipelas on the edge of the wound; and on this account I have latterly put a bit of lint on the edges of the wound after extirpating the female breast, and the adhesive plaster over it. Then, apply the many-tailed bandage loosely, so that it may give way to the tension that follows, and saturate it with some evaporating lotion; the material of which the bandage is made being very convenient for the purpose of retaining the fluid.

Splints should afterwards be put on; those made of wood are the best, and one should be placed on each side of the limb. Do not apply the splints tightly at first, so as to cause pain, but see that they are well padded, and the bones nicely adjusted. In a few days it often happens that inflammation arises, and a discharge of pus follows; the lint which was at first applied should then be partly removed, and the matter allowed to discharge. If the matter be small in quantity, after having let it out, replace the lint carefully, and do not apply a poultice, but con-

..... of the If on the other hand,

contused wound, with a tendency to slough, then it is proper to apply fomentations and poultices, and heal the wound by a granulating process.

^{Position of the} limb. The position of the limb may be just the same as in simple fracture; with this exception, that if the suppurative process should be set up, the wound will require dressing, and therefore it will be necessary to have the limb in a convenient position for that purpose.

The leg. If the *leg* be fractured, it should be bent, and laid on its outer side; for, if it rest on the heel, then the fractured part is without support, and it requires very great attention to prevent deformity of the limb. If, while the leg is lying on its side, the toe is allowed to fall, the foot becomes everted, and the patient seldom recovers a useful limb.

The thigh. If the fracture be in the *thigh*, it should be placed over a double inclined plane, with a splint on each side; that on the outside reaching from the trochanter beyond the knee. Both in this and the former fracture, the ball of the great toe should be kept in a line with the inner side of the patella. I do not like the extended position of the limb, because the muscles are put upon the stretch, and there is danger that shortening of the limb may ensue. This was the practice about fifty years ago. I also object to the lateral position of the limb, as recommended by Mr. Pott, for two reasons. ~~The first is, that it is almost impossible to~~ ^{keep the limb from falling;} ~~the second is,~~ eversion of the

foot is the consequence : and I have seen several patients treated by Mr. Pott, who had this deformity. The *second* objection to this practice is, that the limb, from being kept long in the extended position, causes the motion of the knee joint to be very much diminished, and there is great difficulty subsequently in restoring it.

The arm. In compound fracture of the *humerus*, let the arm hang by the side, with the fore-arm and hand, very slightly supported in a sling, so that its weight may not be entirely taken off the humerus ; for it will tend materially to prescrve the apposition of the ends of the bone. Do not keep the patient in bed, for, in the recumbent posture, the arm is generally placed across the chest, and becoming twisted, causes the fracture to unite badly.

Some fractures more favourable than others A compound fracture of the *femur* generally does better than a compound fracture of the leg, because the bone is so much surrounded by muscle that the wound made is much more easily closed, and is not, therefore, followed by the same degree of suppuration. The humerus generally does well when fractured, on the same account. The worst cases are those of the fore-arm and leg, from inflammation and sloughing of the tendons in the one, and the superficial nature of the covering of the bone in the other.

the symptoms; there are, however, a few circumstances which I consider important to become acquainted with. If the patient be young and plethoric, take blood from the arm, sufficient to allay the constitutional suffering; but do not give purgatives, as they very much disturb the patient, and add to the irritation, by the necessity which there is of his being frequently moved. Nothing is so bad in the treatment of compound fracture as the frequent changing of the positions and dressings of the patient: it is a state of rest which is necessary for the recovery of the parts, and therefore the less they are disturbed the better. Give opium to quiet the irritation, and, at the same time also, give the saline mixture, with the liquor antim., or potassio tartratis, to keep up the secretion of the skin.

Difficulties to be met with in the treatment. I shall next treat of the difficulties sometimes met with in the treatment of these accidents. And first, of the difficulty which now and then exists in the *reduction* of the bone; arising occasionally from a portion of skin being nipped under the projecting extremity of the bone. On trying to extend the limb, you find you cannot bring the skin into its place. If this projecting portion of bone be not large, make an incision through the integuments, turn them on one side sufficiently to reduce the bone, and afterwards try to unite the parts by the adhesion process.

Obliquity of the fracture.

Difficulty is experienced in

the reduction of a fracture which is very *oblique*, do not divide the integuments; as the probabilities are, that the periosteum has been injured on the exposed bone, and that it would afterwards separate by a tedious process of exfoliation. The vitality of the part is very low, and the wound necessary to be made, to replace the bone, would be a large one. But what I advise you to be doing is this, saw off the sharp projections of bone at the extremities of the fractured portions, and then carefully replace the bone in its proper situation. The muscles will draw the ends of the bone together, even if it be shortened. Do not adopt this practice, however, where there are two bones, and one is not fractured; for if the broken, or sawn surfaces be not brought into contact, no ossific union can take place. I know that some cases have been published, by a very ingenious surgeon, in which it was supposed that ossific union had taken place between the separated portions of the tibia; but I think that this union was effected by a tough ligamento-cartilaginous material, and not by bone.

Communition. If the bone be very much shattered, and several pieces be detached and loose, remove them; but with the greatest degree of care, so as to avoid irritating the wound more than is absolutely necessary. If these portions of bone be not removed, they will produce excessive irritation, and will very much retard the healing of the wound by frequent

tach them, for if they be connected by periosteum they will again unite ; or if there be one large piece, and the periosteum on it is entire, let it remain.

Complicated with haemorrhage Compound fractures are often attended with haemorrhage from large arteries, which have been wounded by the broken extremities of the bone. In these accidents it was formerly the practice to amputate, whenever any vessel of importance was wounded ; under the supposition that the injury could not be repaired, and that gangrene would in all probability happen. But I have seen so many limbs saved, even when the principal artery going to the limb has been torn, that I am induced, by experience, to adopt a different plan. Sometimes the anterior tibial artery is torn through. In a case which I perfectly recollect, the vessel was taken up by a tenaculum and secured, and the patient did very well. In one case, where the posterior tibial artery was wounded, it was secured by ligature, and the patient also did well. But in another case of the same kind the man died, but the haemorrhage was stopped by pressing a piece of lint into the wound, and the artery was not tied.

The introduction of extraneous bodies into the wound, to suppress haemorrhage, is wrong in compound fracture, as they produce too much irritation, and do not effectually answer the proposed object. It is better in some cases, where there is great difficulty in securing at the wound, not to be

twitching and pulling and continually irritating the wound, (frequently to little purpose,) but to cut down at once on the artery, in its course to the part. If, for example, the posterior tibial artery be wounded just below the middle of the leg, where it is deeply covered by muscle, it should be cut down upon higher up, and secured. Mr. Hey sawed through the fibula to get at the posterior tibial from the *outer* part of the leg ; but I should recommend it to be secured from the *inner* side of the leg, by making an incision between the gastrocnemii and the tibia, and then cutting through the fascia covering the deep muscles.

I have only known one instance of the femoral artery being divided in compound fracture, and I thought it right to amputate immediately ; the haemorrhage was but slight, but as the artery and vein were both torn through, I considered there was very little chance of saving the limb.

In two cases of division of the brachial artery by fracture, amputation became necessary. In one of these cases I amputated even whilst the gangrene, which had taken place in the lower part of the arm, was extending ; but as this arose only from local injury, the patient did perfectly well.

Treatment of compound fractures extending into joints. If a compound fracture should extend into the *ankle joint*, that, of itself, would form no reason why amputation should be performed.

but the surgeon should be guided, principally, by the nature of the injury, by the age, and also by the constitution of the patient. If the compound fracture, extending into this joint, be oblique, it will generally do well; provided, care be taken to procure adhesion of the wound. This is best effected by applying lint dipped in blood to the lacerated integuments, and allowing it to remain there until it separates spontaneously. The many-tailed bandage should be applied, and kept wet with a spirituous lotion, composed of *sps. vini*, $\frac{3}{j}$. *aquæ*, $\frac{3}{v}$. A splint should be applied on each side, padded with cushions, so as to preserve the great toe in a line with the patella,—an important point on these occasions. Place the leg on its side, semiflexed, so as to relax the muscles, and render the patient's situation as easy as possible. The position, however, will require to be varied, according to the situation of the wound.

If the bone be comminuted, as well as broken into the joint, and if there be bleeding from any large vessel, it will be proper to amputate immediately; more especially if the patient be obliged to work hard for his support, for after recovery from comminution, the limb will bear but a slight degree of exertion.

If, however, the constitution be good, and the person be about the middle age, it is right to take away the small pieces of bone, heal the wound by

adhesion, and produce ankylosis. In one case suppuration even followed, and the patient did perfectly well.

If a compound fracture extend into the *knee joint*, and the opening be large, it will be necessary to amputate, as the constitutional disturbance will be exceedingly great, and run the risk of destroying the patient. If, however, the opening be small, try to procure adhesion, and thus make it a simple wound. When the condyles of the femur are broken into the joint, the limb is to be placed on a pillow in the straight position, and evaporating lotions and leeches are to be used to subdue the inflammation and swelling which necessarily attend this accident. Supposing the external wound to have closed, then apply pieces of paste-board, moistened by being soaked in warm water, about sixteen inches long, and broad enough to reach under the joint; and have them confined by a roller. When these dry, they will be found exactly adapted to the shape of the joint, and afterwards retain their form, so as best to confine the bones. I prefer the straight position in these cases, because the tibia presses the extremity of the broken condyle into a line with that which is not injured.

Compound fractures of the *elbow joint* generally happen through the internal condyles of the os humeri, and the fracture takes an oblique direction into the joint. The joint is generally able to sup-

be judiciously managed; I could mention several cases which would prove the success of the practice of effecting union by adhesion. A case now presents itself to my recollection, of which I will give an outline.

Case. I was called to St. Thomas's Hospital, to see a brewer's servant who had a compound fracture of the elbow joint, from the dray passing over his arm, which had considerably comminuted the bones. I could pass my finger readily into the joint, and feel the brachial artery pulsating on its fore part. Considering the violence done to the joint, and the constitution of the patient; (men in such employment being in the habit of drinking largely of porter and spirits, and therefore render their constitutions exceedingly irritable;) I told him, that I feared there was scarcely any chance of his recovery unless he consented to have the limb removed; this he determined, however, not to submit to, and I therefore did all in my power to save both his life and his limb. The bones were easily replaced, and the parts were brought carefully together. The limb was laid upon a splint, a bandage was lightly applied, and the forearm was placed at right angles with the upper arm. The wound united without any untoward circumstances; and the only thing that happened, which appeared in the least to retard his recovery, was the formation of an abscess in his shoulder, which was opened, and im'
'ed. The joint was not

even completely ankylosed, for he retained sufficient motion to allow him to resume his former occupation.

If a contrary practice be adopted, if poultices, for example, be applied, the adhesive process is prevented, and suppuration produced, which puts life in danger, or renders amputation necessary. I will now give the result of a case where this practice was followed.

A woman between fifty and sixty years of age was admitted into Guy's Hospital, with a wound of the elbow joint, and fracture of both the condyles of the os humeri. A poultice was directed to be applied, and fomentations ordered twice in the day. On the day following the accident, she had a considerable degree of fever. On the third day, the upper arm was exceedingly swollen, attended with a copious sanguous discharge from the wound. On the fourth day, her strength was greatly reduced, and the wound had almost ceased to discharge, but the arm was very much swollen; and on the fifth day she died. *

In all cases of this accident, the arm should be kept in the bent position; for as ankylosis in a greater or less degree will be the consequence, it is attended with much less inconvenience in this position than in any other. If the bones be very much comminuted and the wound large, all the detached portions of bone should be removed, and the

people, when much injury is done, there is often not sufficient strength to support the suppurative process, and amputation should be recommended. The edges of the wound should be kept together by placing a piece of lint dipped in blood over them, and a bandage lightly applied, wetted with spirits of wine and water. Even if it should suppurate, it will not be necessary to amputate, unless any thing particular should afterwards happen.

A compound fracture extending into the *wrist joint* is a very serious accident when the radius is much comminuted ; but it does very well, when the radius is broken without being much shattered. I saw a case of this injury in a patient in the country, where the man met with the accident by falling upon the back of his hand, and the ulna protruded an inch and a half through the integuments ; the bone was immediately reduced and bandaged lightly : the wound healed by the adhesive process, and the man recovered the perfect use of the limb. I recollect another case of the same kind, which came under the care of Mr. Chandler, in Guy's Hospital ; I now forget in what manner the accident happened, but the ulna projected through the integuments at the back of the carpus, and a compound fracture of the radius, with great comminution of the bone, was produced. The ulna was first replaced, but immediately resumed its dislocated position on the back of the wrist although it did not again protude

through the skin. The hand and fore-arm were placed in a poultice, and were ordered to be fomented twice in the day. A copious suppuration ensued, attended with violent constitutional irritation; and Mr. Chandler, in order to save the patient's life, after a lapse of several weeks, amputated the limb.

In a similar case, it would be proper, when broken pieces of bone can be felt at the extremities of the radius, that the wound should be enlarged for their removal; and instead of fomentations and poultices being used, that the wrist should be surrounded by lint dipped in the blood, and a roller loosely applied. The arm should be supported on a splint, so as to keep it perfectly free from motion; evaporating lotions should be applied, and the limb should not be disturbed unless the patient has symptoms of a suppurative process, when a small opening should be made in the bandage to allow of the escape of pus; but still the bandages should be suffered to remain. If the inflammation and constitutional irritation be considerable, the patient should be bled from the arm, and leeches should, under these circumstances, be occasionally applied. The bowels should be kept gently open, but all active purging avoided. If the suppurative process have extended up the tendons of the fore-arm, it will be necessary to amputate. The operation should not be performed where the tendons are loose in the arm, but further up, in the muscular

part of it; otherwise, a sloughy, irritable stump will be the result.

High degree of inflammation. Another untoward circumstance is a high degree of inflammation attacking the neighbouring parts. If the patient's general health be good, the inflammation will not extend beyond a few inches around the accident. But if the patient be irritable, and the injury be in the leg, for example, the inflammation will extend along the course of the absorbents to the groin; and, if there be effusion at the same time accompanying this, it must be considered as an indication of great danger. Such appearances must be treated, very actively, by depletion; apply leeches, fomentations, and poultices to the neighbourhood of the wound. Lotions of the liquor ammoniæ acetatis, with rectified spirits of wine, should be applied to the inflammation on the limb, whilst the poultice is applied to the neighbourhood of the wound. At the same time, opium should be given to allay the constitutional irritability, and a gentle diaphoresis promoted on the skin, by giving some saline medicines, as the liq. ammon. acet. These symptoms generally make their appearance in persons who have lived irregularly, either as regards their diet or their habits. Be very cautious about the administration of purgatives, as they disturb the patient very much; but if absolutely necessary, give an enema.

Spasmodic ac-
tion.

Another obstacle met with in the treatment of compound fracture is an excessive spasmodic action of the muscles. This action is sometimes so violent as to render all attempts to overcome it absolutely nugatory. In one case it disturbed the limb so much, as to render amputation necessary; and, on dissection, a piece of bone was found, separated from the other parts, and locked between the extremities of the bone.

Treatment for
non-union.

It is sometimes necessary to amputate, from a want of union between the fractured ends of the bone; and on this subject I can furnish the knowledge of a circumstance that may be of the greatest importance in future practice. Many recollect having seen me amputate, a short time since*, the leg of a young woman in Dorcas' Ward, for great deformity of the limb; it unfitted her for any of the active duties of life, and she therefore became desirous of having it removed. The bone was fractured, by some mismanagement or other, during the process of parturition; and although she is now about nineteen years of age, there has not been the least attempt made towards ossific union. The part where the fracture took place is as flexible as a joint, and I therefore wish to put others on their guard, so that they may be very careful to avoid so distressing an accident. I have met with other cases of a simi-

lar description, and therefore I am inclined to think that it is generally the result of fractures occurring at that period.

The ordinary treatment of these cases is, to bandage the limb firmly, buckle on a case of firm leather over the limb, and adjust carefully a splint on each side of it, so that no lateral motion may be allowed. If it should happen in the leg, let the patient walk as much as she can on crutches, and thus, by making pressure on the ends of the bone, bring on a sufficient degree of inflammation to throw out adhesive and afterwards ossific matter. Non-union is sometimes, I believe, the result of continuing cold applications for too long a period to the part, thus checking that degree of inflammatory action which is absolutely necessary to bring about a restoration of the parts. But if the case be properly managed, it is generally unnecessary to amputate in this state of the parts. Mr. Amesbury's splints will be found very useful in the treatment of such cases ; they have been used at Guy's Hospital frequently, and I believe have been successful in accomplishing the desired object.

Complicated
with tetanus. It has been recommended to amputate parts, which have been injured by compound fracture, when tetanus makes its appearance. But do not adopt this practice, as, in those cases where I have seen the practice tried, I have not observed it to be successful. What I conceive to be better, is, to put

some of the extract of opium, liquefied by the addition of a little water, into the wound : I have known this succeed when large doses of musk and opium had been taken without producing any effect.

When is the most proper time to amputate, if necessary? All the circumstances before mentioned being taken into account ; if it will be necessary to amputate in a few days after the accident, then, the sooner it is done the better.

If we amputate at one hour after the accident, the patient will do better than if we leave it for twelve hours. For this reason, if we amputate immediately, the constitution has but one shock to sustain, and in general rallies much better than when the amputation is delayed. But if it is left for eight or twelve hours, a great degree of irritation is previously set up. The *loss of blood* is rather a favourable circumstance than otherwise to precede the operation. The persons, in whom these operations succeed worst, are such as are loaded with adipose matter ; if the limb be left, the constitutional irritation runs so high, that it generally destroys life, and if we amputate, they frequently die in twenty-four hours after the operation, from the constitution being unable to bear the shock which that operation produces.

The cases of compound fracture admitted into these hospitals generally do well, in the proportion of about three to four ; which circumstance, I think, alone would furnish an incontrovertible proof of the

superiority of the treatment by adhesion to that which was formerly employed.

SECTION VII.

PROCESS BY WHICH BROKEN BONES UNITE.

A solution of continuity in the soft parts unites with wonderful quickness, the cure by adhesion taking place in a few hours. The process of union in bones is slower and more complicated, nature requiring a longer time for the reparation of a fracture than for the union of a wound, and the process not being, in the first case, so simple, clear, and manifest. Even at the present day, with all the assistance of experiment and actual dissection, different statements and theories are advanced by different authorities.

A few years ago, lecturers on surgery got over this subject very easily, and those teachers, whom I happened to attend, explained the matter in a concise and summary way, by stating, that the only difference between the union of bone and that of soft parts, was, that the coagulating lymph effused between the ends of a fracture, gradually acquired the consistence of cartilage, earthy matter was deposited in it, and thus the bone was united, and acquired its former strength, the only peculiarity being in fact the deposit of phosphate of lime as the uniting medium.

Du Hamel's theory.

But, even before the time alluded to, considerable progress had been made in the investigation of the process by which broken bones unite; and great merit is due to Du Hamel for the success with which he examined this part of surgical pathology. After making numerous experiments to ascertain the steps adopted by nature in uniting broken bones, he inferred that the periosteum and the medullary membrane were the sources of the new bony matter, or *callus*, as it is called, or of the substance which was the means of union. The periosteum and the medullary membrane he considered as the exclusive organs of ossification. He maintained that, in the process by which a broken bone is united, the periosteum, covering the end of one fragment, grows to that of the other, and then swells and forms an elevation round the fracture. In the swelled portion of the periosteum, he described vessels as becoming developed, and depositing specks of osseous matter, which formed a kind of ferule or hoop, directly round the fracture. Now this explanation partly agrees with later observations, and especially with those made with so much care by Baron Dupuytren. Besides the changes leading to the production of the *external callus*, Du Hamel found, that the medullary membrane was not inactive; but contributed its share in the promotion of union in nearly the same degree as the periosteum. One error in Du Hamel's theory, however, was the

supposition, that the bony ferule would permanently remain, as the bond of union. It is occasionally asserted, that the periosteum is exclusively the organ of ossification. Without entering into a minute consideration of the objections to the latter opinion, be it sufficient to say, that callus, or new bony matter, is often produced in parts where the periosteum is totally destroyed; and it is well known, that the patella may be united by bone, although it is not furnished with a periosteum at all. It is true, that it rarely unites by osseous matter when broken transversely, but when fractured by external violence, or in the longitudinal direction, osseous union is not an uncommon result.

Bordenaave's theory. Bordenaave having had an opportunity of examining a bone, that had been formerly broken and long united, and, finding no bony ferule in the situation of the previous fracture, conceived that Du Hamel had been mistaken; and he therefore espoused the doctrine, that union is accomplished by the vessels of the bone itself, and that they effuse coagulating lymph between the ends of the fragments, which lymph is first converted into cartilage, and finally into an osseous consistence. Barron Larrey also rejects the theory, that the periosteum is the organ of ossification, and he adverts to examples, where, although portions of the cranium had been removed, and the pericranium had been destroyed to a considerable extent, nature made considerable

efforts to repair the loss. In young subjects, especially, such efforts may indeed accomplish a great deal, and, I think we must acknowledge, that the facts and arguments brought forward by Larrey, amount to a refutation of the opinion, that the periosteum is exclusively the organ of ossification.

The opinions of Dupuytren, and others The experiments of Dupuytren, Villemé, and Breschet prove, that all the doctrines to which I have adverted are too limited. Whenever a bone is broken, the soft parts around the injury are more or less contused and torn, and it is alleged, that not only the periosteum and medullary membrane, but also the soft parts around the fracture, (the cellular tissue, and muscles, or rather their vessels,) are concerned in repairing the injury of the bone. It was found, that when the ends of the fragments were kept steadily together, they became surrounded by a swelling and a subsequent ossification of the soft parts; and, that in this manner, a kind of external case was formed to include and support the ends of the bone. This first production corresponds with Du Hamel's bony ferule; for, as I have said, he noticed that a sort of bony hoop is produced around the fracture. Dupuytren calls this hoop, or ferule, the *provisional callus*, because it is only a temporary production, and is absorbed as soon as it has fulfilled the purpose for which it is designed; namely, that of acting as a splint, or means of support to the broken part of the bone, until nature has

had time to bring about a more complete and direct union of the ends of the bone themselves.

The different stages. It has long been familiarly known, that callus is not formed suddenly; that it requires more or less time for its production; and that the broken part of the bone only obtains solidity by degrees. Now, before the work of reparation is complete, several changes happen in succession. Hence, the process is now usually divided by pathologists into several stages.

The first stage. In the first stage then, of the union of a fractured bone, comprising a period of about ten days, there is merely a swelling of the soft parts around the fracture; and on examination of the limb, in the dead subject, the swelling appears to consist of a reddish substance, as would seem from the quantity of blood effused. The swelling is greatest or thickest opposite to the fracture, and gradually diminishes above and below the injury, till it is completely lost in each of these directions. About the *tenth day* the redness disappears, the blood being now absorbed and coagulating lymph effused.

The second stage. At this time a reddish, vascular, spongy substance is formed between the ends of the bone, which substance is not itself of an osseous nature. Specks of bone now begin to be deposited in the swelling around the fracture, a change or new action, characterising the beginning of the second stage, which extends from the tenth until the twenty-

fifth day. During this stage, the effused lymph on the outside of the fracture becomes ossified; it first assumes a fibrous structure; then becomes cartilaginous; and, by degrees, calcareous matter is deposited in it. In the meanwhile, similar changes are going on in the medullary membrane, so that, in the process of union, nature is labouring, without and within the bone, to give it a temporary means of support and steadiness; while the principal and permanent work of ossification is as yet only preparing for commencement. The bone is still capable of partial flexion; the ends of the fracture not being yet consolidated.

The third stage. In the third stage, extending from the twenty-fifth day to the end of the sixth or eighth week, the external swelling becomes completely ossified and firm; the internal medullary membrane undergoes the same change; but the ends of the fracture are not united, and support is only afforded by the external and internal osseous formations. The ends of the fracture are not yet directly consolidated together; and the bone may still be broken again, or bent, by any violence or weight applied to it in a careless manner.

The fourth stage. The fourth stage extends from the sixth or eighth week, to the end of the fifth or sixth month; during which time the external or provisional callus has become completely ossified, and even covered with periosteum. The ossification of the me-

dullary membrane is also perfected ; and the ends of the bone being now truly united to each other, by bony matter, the former solution of continuity is hardly distinguishable.

The fifth stage. The fifth stage reaches from the fifth or sixth to the twelfth month. During this period, the external provisional callus is absorbed and removed ; and the direct union of the fragments is so strong, that it would be as difficult to break the bone in the situation of the former fracture, as in any other place. For a certain time after the injury, the medullary cavity is filled up by a kind of internal provisional callus, obliterating, as it were, the cavity of the bone. These final changes take place in the interval between the sixth and the twelfth months ; then, all irregularities are removed, the external callus is absorbed, and the medullary canal restored.

In the Hunterian collection at the College of Surgeons, there is a bone united in such a manner, that a portion of its medullary cavity is turned outwards, instead of inwards ; a large splinter having been entirely detached : yet union took place. Long splinters and fragments frequently unite, but they sometimes perish, and fall into the state of necrosis.

The source of the provisional callus. The source of the external provisional callus is not, then, exclusively in the vessels of the periosteum, but the surrounding cellular substance and muscles have a share in the

production of it ; and this in a still greater degree, when the ends of the fracture are considerably displaced. The formation of the definitive or permanent callus, which follows that of the temporary one, is not completed till the eighth, ninth, or even the tenth month after the accident. When this is finished, the provisional callus becomes unnecessary ; nature therefore not only removes it, but also that which is formed in the medullary cavity ; and this becomes restored to its original state. All these changes however, are not brought about until long after the occurrence of the fracture ; much longer than was formerly supposed.

Characteristics of
provisional callus The provisional differs from the definitive callus, not only in its situation and duration, but also in its lesser consistence and solidity. When it is finished, it only possesses the strength necessary to resist the action of the muscles and the weight of the part ; nay, there are cases in which, on the removal of the splints, it will yield to these two forces, especially in oblique fractures. It is of consequence for the surgeon to recollect that the limb may be straight so long as the splints remain applied ; but, that from the too great weight on the limb, or the too powerful action of the muscles after the removal of those supports, deformity may still ensue. If the splints are removed too soon, or the part be used too roughly and boldly, (while the strength of the fractured bone depends

entirely on the external and internal provisional calli in a certain stage of their formation,) it is possible that a degree of deformity may yet follow. Sometimes the strength of the provisional callus will be overcome by a shock or blow, or some other form of external violence, and sometimes by the effects of constitutional disease. I have seen patients with bad fractures, whose limbs had proceeded to a certain extent in the process of cure, when they were attacked with fever; the provisional callus being so weakened as to admit of easy flexion, though it had previously been quite inflexible. This fact proves that the provisional callus is weaker than the definitive one; and the knowledge of it is useful; for, supposing a limb to be badly set, if the provisional callus has only advanced to a certain stage, an attempt may yet be made to improve the shape of the limb. This has been done in France with success. Yet it must be manifest, that the older the provisional callus is, the more difficult will it be to amend the shape of the bone; for the callus becomes firmer and more unyielding, in proportion as its ossification is more advanced.

Definitive callus. The definitive callus, though less bulky than the provisional one, is harder, stronger, and more compact, being indeed, when it is perfectly finished, stronger than the rest of the bone; and, if the bone be broken again, the fracture will not be in the situation of the definitive callus. Leaving out of

present consideration the effects of scurvy, I may say, that the definitive callus is never destroyed by disease. In this respect also, it is stronger than the provisional callus, and whatever deformity may exist in the limb, after the definitive callus is formed, cannot be lessened.

Hitherto, I have been considering chiefly, the process of union in simple fractures of the long cylindrical bones, which have been properly set. When the two ends of a fracture are in apposition, only at one point of each of their surfaces, definitive callus of the ordinary kind can only be formed at this point ; but, as a compensation for this disadvantage, the external callus is never entirely absorbed, but remains as a substitute for what would be the definitive one under common circumstances. When the two surfaces of the fracture are not at all in contact, and the ends of the bones touch one another laterally, strictly speaking, there is no provisional callus. In such a case, not only the periosteum, but the vessels of the adjacent cellular membrane and muscles, assist in the work of producing new bone, by which the two fragments are to be connected ; the side of one fragment becomes soldered by osseous matter to the side of the other, and whatever new bone is formed for this purpose remains permanent, or, in other words, is a definitive callus.

" The instances in which union is effected through a process originating in the bone itself, are fractures of the cranium, and of the neck of the thigh bone within the capsular ligament. In the first of these cases, no provisional callus is formed ; in the second, it has no means of reaching the fracture. It is difficult to explain why a provisional callus does not form about fractures of the cranial bones. The physical cause of this negative phenomenon is not known. The final cause, however, is evident. If a hard swelling, such as a provisional callus, were stretched, as a ridge, along the inner aspect of a cranial fracture, it would encroach upon the cavity ; and hemiplegia, epilepsy, or some other form of cerebral disorder would attend every fracture of the skull. No callus therefore is formed ; but the fracture, after a time, shows a disposition to unite, through forces inherent in the bone itself, &c. In a fissure of the skull, examined some months after the injury, the only change apparent is a rounding of the edges externally. After a year or two, the fissure is united at its internal or cerebral aspect. After the lapse of many years, the narrowest part of the fissure is entirely filled up. In persons who have lived ten, twenty, or fifty years after the loss of portions of the cranium, the slow restoration of the bone appears to have been progressive for the whole period. In fifty years, a trephine hole nearly closed by the

shelving growth of bone, from the margin towards the centre." *

The causes of difficulty in procuring union of fractures of the cervix femoris within the capsular ligament, will be considered hereafter.

In compound fractures. Lastly, in compound fractures attended with suppuration, the bones remain disunited for several weeks, and then union takes place in a different manner to what I have been explaining. In this instance, no provisional callus is produced; but at the end of several weeks, the ends of the bone soften and granulate, and, in proportion as the secretion of pus subsides, the granulations of the surface of the fracture deposit osseous matter, or, as the French pathologists say, they are themselves converted into bone. It appears then, that the process of union in compound fractures is different from what it is in simple ones; it will generally be found, the greater the degree of displacement of the fracture, and the greater the injury done to the surrounding soft parts, the less will the work of producing external provisional callus be confined to the periosteum †.

Bony union of cartilage. Broken cartilages do not unite by cartilage, but by bone; osseous matter is deposited around the part, forming a kind of hoop or ferule, which is alleged to be formed by the vessels of the

* Mayo's Outlines of Human Pathology, p. 8.

† See page 287

perichondrium. This mode of union is exemplified in fractures of the cartilages of the ribs. Fractures of the patella, olecranon, condyles of the humerus, and coronoid process of the ulna, generally unite by means of a fibrous ligamentous substance, and the acromion, when fractured, may also unite in the same manner.

The time required for union. Different bones require different lengths of time for the union of their fractures. In the upper extremities, fractures are sooner cured than in the lower ones ; the ribs and clavicle are generally united with tolerable firmness in about a month ; and even sooner, in young subjects. Fractures of the humerus require about six weeks for their reparation ; but those of the tibia and femur are not firmly united before the eighth week. When I speak of bones being *firmly united* at particular periods, I allude only to that firmness which is derived from the provisional callus, and do not mean that the definitive callus has been produced. The latter work, which may be regarded as the completion of the cure, is not accomplished till a much later period.

The time required for the union of a broken bone, will also be much influenced by the age of the patient, his state of health, and the efficiency or inefficiency of the treatment adopted. In infants, a broken bone will make as much progress towards a cure in one week, as it would in a month in the adult. When the bones of infants happen to be broken

during parturition, they are generally united with considerable firmness in a week or ten days. The tendency to quick union is strongly evinced during the development of the skeleton, that is, while the individual is growing; and, I may say, that it is most considerable while this development is taking place with the greatest vigour. Hence the impossibility of keeping children quiet does not seem to interrupt the process by which a fracture unites; and however much they may move and toss themselves about, the injury is generally repaired with wonderful expedition. This is a circumstance which should always be remembered in the treatment of fractures in children; for, if these accidents are not vigilantly attended to during the first ten days, and the position of the broken bone is neglected, we may afterwards find the process of union too far advanced to admit of the shape of the limb being rendered better again. Circumstances are different in the adult, in whom the ossific process does not actually commence till after the tenth day; a fact which led Dr. Hammick and some other surgeons to defer the application of splints during such space of time, and merely to employ cold lotions, with the view of keeping down inflammation. This practice would not be advisable in the case of children; for, after the ten days had elapsed, we should most frequently have to regret the omission of the use of splints, by means of which, i

might have had effectual command over the shape and direction of the limb, but which would now perhaps be irremediably deformed.

Circumstances which retard union.

Age, or disturbance of the system. The process of union is retarded by old age, and by every temporary disturbance of the system : such as an attack of fever or erysipelas. The union then always proceeds more slowly, or may even be completely suspended. The process is retarded also by several of those diseases which sometimes operate as predisposing causes of fractures ; as, for instance, certain diseases which weaken the texture of the whole skeleton, or that of particular bones, the chief of which are rickets, fragilitas and mollities ossium, cancer, scrofula, and, as some allege, the venereal disease in its advanced stages. But, with regard to this last disease, I must observe, that it is disputed whether the condition of the bones may not be brought on rather by the mercury which is given for the cure of the disease, than by the disease itself.

Pregnancy. Pregnancy is generally set down as one of the causes impeding bony union, and it is even asserted, that fractured bones in pregnant women will not unite until after delivery ; but this is not always the case, for I once attended a woman, that lived in the neighbourhood of St. Paul's, who had both bones of her leg in the fifth or sixth

month of pregnancy; yet the fracture united favourably, and in about the usual time.

The presence of a sequestrum. Another circumstance sometimes retarding the union of a fracture, is the lodgment of a dead portion of bone between the ends of the two fragments. In the museum of the London University there are several preparations exhibiting this fact. In the writings of Schmucker, an interesting case is related, in which a portion of dead bone was lodged between the fragments of a broken tibia, and retarded the uniting process for eight months; at the end of which time an incision was made and the sequestrum taken out, after which the union took place in three or four weeks.

The continuance of a fracture in a disunited state depends sometimes on constitutional causes, and sometimes on circumstances directly affecting the broken bone itself. Among the latter causes, I may specify a total want of apposition between the two ends of the fracture. If the bones do not touch at all, there will probably be no union, or, at any rate, the union will take place very tardily.

Motion of the limb. Another circumstance, contributing to prevent union, is moving the fractured limb too frequently, or even continually, by which the ends of the bone are prevented from being in steady apposition. We shall find a remarkable proof of this recorded by Baron Larrey. When the French army

was retreating from Syria, there were among the wounded a great number of soldiers with compound fractures, whom it was necessary to place on the backs of dromedaries and camels, in order that they might travel with the rest of the army: for if they had been left behind they would have been murdered by the Turks and Arabs. They were obliged to continue their retreat day and night for several weeks, jolted very roughly in this mode of travelling; the consequence of which was, that many of these fractures did not unite by osseous matter, and were sent to Marseilles, a year after the period of the retreat from Syria, still uncured. Too much motion of a broken limb is, then, one of the circumstances impeding the favourable union of fractures, and occasions what is called a *false joint*; indeed, one of the principal indications in the treatment of fractures is to prevent all motion of a fractured part.

Interposition of a portion of muscle. Another circumstance impeding the union of fractures, and first pointed out, I believe, in my* writings, is the interposition of a portion of muscle between the ends of the broken part of the bone. I have been present at one or two dissections, in which the want of union was ascertained to be produced by this cause. In one of these instances, where the humerus had been fractured obliquely, the lower fragment, (the end of which was sharp,) had been

* Mr. S. Cooper.

drawn up into the biceps muscle; consequently, there was no apposition of the ends of the fracture, as a quantity of muscle intervened between them.

Cases of non-union.—The greater number of fractures, not uniting by bone, are either in the patella, in the neck of the thigh bone, or in the shaft of the humerus. With regard to the humerus, I may observe, that most of those fractures, which do not unite by bone, take place just below the insertion of the deltoid: here the upper fragment is pulled outwards by this muscle, while the lower one is drawn inwards by the coraco-brachialis. The failure of union, therefore, seems to depend upon the non-apposition of the ends of the fracture; and, perhaps, upon their disturbance by the action of the muscles in question.

Besides these cases, false joints or union by ligament may also happen in other bones, or other parts of bones; thus, sometimes a fracture of the shaft of the femur will either not unite by bone at all, or very tardily; fractures of the lower jaw may fail to be reunited by osseous matter, or the process may be very late in its completion. Two years ago, there was a man in the King's Bench with a fractured radius, which had been in that state a long while, and there was not the slightest degree of bony union when I last saw the case. A fractured tibia, too, will sometimes not unite in the regular way. I have seen two cases which did not unite by bone for nearly two years,

SECTION VIII.

UNUNITED FRACTURES.

Sometimes fractures continue for a long time, without evincing any disposition to unite; in other instances, they lose all tendency to be consolidated by osseous matter, the ends of the bone becoming rounded, smooth, and connected only by a fibrous ligamentous substance. When this mode of union takes place, the case is said to terminate in the formation of an *artificial joint*. A main point in the treatment of such fractures, as have continued a long time without osseous union, is to ascertain the cause of the deviation from what is the usual course of things; for here, as well as in every other part of surgical practice, the cause of what is wrong should be investigated, because, as soon as it is removed, the effects will probably cease.

Causes of non-union. If the continuance of a fracture in a disunited state were to depend on general indisposition or bad health, which could be removed, the cure of the injury of the bone would then, perhaps, admit of being accomplished; but sometimes the cause of want of union in the fracture depends on a constitutional disease which is totally incurable. Thus, when no callus forms in a patient with cancer, there is little prospect of bringing about the union ~~one by~~ ~~matter~~, because no means are

known by which the original disease can be cured, or the patient's state of health materially improved. The same may be said of mollities and fragilitas ossium, and of some other constitutional affections, in which we have no means capable of leading to the re-establishment of a sound state of the constitution. However, many diseases, that retard the union of fractured bones by osseous matter, do admit of cure : such are rickets, scurvy, and lues venerea in its advanced stages. In these instances we may hope, by proper treatment, to bring about such an improvement in the health as will be followed by a deposit of bony matter for the union of the fracture. It is certain, however, that diseased bones will sometimes unite. Sir Benjamin Brodie had a syphilitic patient, with an enlarged clavicle, which broke, from some exertion of the arm, the fracture extending through the diseased part ; yet this fracture united in the ordinary time. With regard to rickets, I have attended many children in this state with fractured limbs, and in all these examples there was no remarkable indisposition of the broken bones to undergo bony union. Also with respect to a pregnant woman, whom I attended with a fracture of both bones of the leg, the bones united very well in about the usual time. Cases are met with in which the formation of callus is kept back by illness excited by the fracture, or

Thus, there will sometimes be an attack of fever or erysipelas, in which events, the formation of callus will be retarded as long as the general indisposition continues. Sir Benjamin Brodie has seen two cases, where fractures did not unite, in consequence of the constitution having been impaired by a kind of voluntary starvation to reduce the *embonpoint* of the individuals : he also suspects, that too tight a bandage may sometimes impede the process of union.

Treatment. When the want of union is owing to the fragments not being properly in contact, or to the fracture not being well set, or to its being moved about too much, then the indication will be obvious ; —the bone must be better set,—the fragments must be put in a state of more accurate coaptation,—and such an apparatus employed, and such quietude of the limb observed, as will more effectually and steadily maintain the reduction. These means, however, will only answer when an artificial joint is not completely formed ; for, after this has happened, no improvement of the general health, nor any means calculated to render the limb more motionless, will be attended with success.

If there were interposition of any soft parts, such as portions of muscle, between the ends of the broken bone, and we were sure that such complication was the cause of want of union, and could not get the ~~ends of the fracture together~~ by freely extending the ~~ion of the bones,~~ we

should then be justified in making an incision, and dividing the muscle interposed between the ends of the bone ; but, I believe, the diagnosis would never be clear enough to vindicate such an operation. In the same manner, if a portion of dead bone (*a sequestrum*, as it is termed) were to intervene between the ends of the fracture, and to prevent union, or retard it for a great length of time, the indication would be obvious enough : we should be required to make such an incision as would enable us to remove the sequestrum. Some fractures do not unite by bone, or do not readily admit of osseous union, in consequence of anatomical circumstances. These are believed to have some considerable share in making it difficult to unite certain fractures of the neck of the thigh-bone by osseous matter. Fissures of the cranium are very slow in uniting.

When a fracture has remained a considerable time without union, and common measures have been found unavailing, various methods for expediting the process of osseous union have been proposed by surgeons. The most ancient is that of moving the ends of the broken bone freely one upon another, so as to excite a degree of inflammation in the parts about the injury ; this plan has occasionally led to the establishment of the requisite process for the formation of callus. When John Hunter had occasion to treat patients in this condition, he sometimes them get

have seen this method tried at St. Bartholomew's Hospital, where it was not uncommonly resorted to at the period of my apprenticeship there. However, if an artificial joint be already formed, this plan will not have the desired effect, and other expedients will be necessary.

^{Removal of the ends of the bone.} One of these, first suggested by Mr. Charles White, of Manchester, consists in making an incision down to the fracture, and dividing the ligamentous connexion, then turning out the two ends of the bone and sawing them off; the limb being next carefully put up in splints, as in a case of recent fracture, and care taken that the two ends of the fracture are as correctly in contact as possible, and steadily thus maintained. The first operation of this kind, performed by Mr. White, was attended with the most encouraging success: the case was one of a broken humerus, that had remained for a long time without bony union. The proceeding has been repeated by other surgeons, and with various results: sometimes the plan has had the desired effect, and sometimes it has not answered; nay, in certain instances, it has not only failed in procuring union of the bone, but occasioned loss of life. Richerand and Larrey mention cases which had this unfortunate termination. I remember a man in St. Bartholomew's Hospital, who broke his humerus, and the instead of uniting, led to the production of simple, Mr. Long cut

down to the fracture and sawed off the ends of the bone ; but, although this was most completely done, and the greatest care afterwards taken to keep the ends of the bone steadily in contact, no bony union followed.

Introduction of
a seton. Of late years, therefore, surgeons have been more shy of resorting to White's operation, and not solely on account of its results having sometimes been so unfortunate, but also because another method has been proposed, which is, at all events, milder, if not more successful. The method to which I allude, consists in introducing a *seton* between the ends of the disunited bone, in order to excite such inflammation in the situation of the fracture as may be followed by the formation of callus. The late Dr. Physic, of New York, proposed the seton, which he tried with success, first in a case of fracture of the lower jaw-bone, and afterwards in an instance of broken thigh that had remained a long time without union. Experience has since proved, however, that the seton fails in a certain proportion of cases : I have seen two in which it did not answer, although it had the fairest trial. The success of the seton, then, is very uncertain ; but, as it is a less severe expedient than that of cutting down to the fracture and sawing off the ends of the bone, it seems to me to merit the preference. It may not answer ; but its danger is not out !

instances, however, the ends of the fracture were not sawn off, but merely scraped.

^{Mr. Amesbury's} ~~plan.~~ Instead of these methods, Mr. Amesbury thinks that another practice, which is still milder than that of the seton, will generally answer; namely, pressing the ends of the fracture methodically and strongly together. Thus, when the humerus is broken, and the fracture is transverse, the pressure is made in the longitudinal direction, which is effected by means of a short sling, and an apparatus expressly calculated to fulfil the indication; but when the fracture is oblique, the pressure is made in the transverse direction, and with the requisite degree of force. This treatment has proved successful in several cases, and, as it is a mild and simple plan, I think that it ought always to be tried before the other more severe methods are resorted to. But, if an artificial joint were already completely formed, I should not expect that this mode of treatment would be effectual.

^{Appearance on} ~~dissection.~~ When a fracture of long standing, and not united by bone, is dissected, the union is generally ligamentous, though the uniting substance differs from common ligament in not having a distinctly fibrous structure. In other cases, there is absolutely a false joint produced; the rounded ends of the bones are covered by a thin ligamentous substance, and the inner surface of the capsule is lined by ~~a smooth membrane,~~ like the synovial membrane,

and, as Sir Benjamin Brodie observes, capable of secreting the synovia. It is only where the want of osseous union causes loss of the use of a limb, or other serious grievance, that any severe operation for the purpose of exciting ossification would be justifiable. A disunited fracture of the rib would not demand it ; nor would some other cases promise any benefit from it.

PARTICULAR FRACTURES.

CHAPTER I.

FRACTURE OF THE FACIAL BONES.

SECTION I.

FRACTURES OF THE OSSA NASI.

FRACTURES of the ossa nasi are by no means unfrequent accidents, a circumstance accounted for by the prominence which these bones form, and their being so little protected by the soft parts. This injury can only happen from direct external violence, as blows, or falls on the face.

Signs of. Besides being accompanied by evident marks of contusion, there is bleeding from the nose ; and in consequence of the moveable state of the pieces of bone, a crepitus can be felt. In some instances, the fragments are not at all displaced ; but in others, where the force applied has been greater, the ossa nasi are driven inwards towards the nasal fossæ, and, if there has been time for much of the soft parts to come on, the injury and

depression of the bone is to be ascertained by manual examination ; for the tumefaction will conceal from the eye, the nature of the accident.

Sometimes the fracture extends through the nasal process of the upper jaw bone, and across the ductus nasalis, attended with a great deal of ecchymosis, a regurgitation of blood from the lachrymal puncta, and an impediment to the passage of the tears into the nose. Such a case came under the care of Mr. Hooper, of the London Road, about three years ago. The injury was produced by a scrubbing-brush being thrown in the patient's face with immense force. There was likewise injury of the brain ; and the case soon ended fatally.

Lastly, the violence may be transmitted through the perpendicular plate of the ethmoid bone to its cribriform plate, which may also break, and symptoms of pressure, or injury of the brain, be excited. In other instances there may be no fracture of the cribriform plate, yet the brain suffer concussion.

Treatment. When a fracture of the ossa nasi is not attended with displacement, all that is requisite to be done is to apply some discutient lotion, or cold evaporating wash to the part ; but, if the fragments are beaten inwards, they should be restored to their proper situation, by introducing a director up the nostril, and adjusting the pieces of bone with the aid of the fingers applied externally.

Generally, when the fragments are replaced, they have no disposition to quit their situation again ; but, cases are mentioned, in which it was judged necessary to afford them some support, by means of lint passed up the nostril. When the soft parts are much swollen, bleeding, leeches, and other antiphlogistic means are indicated.

SECTION II.

FRACTURES OF THE CHEEK AND UPPER JAW BONES.

Fractures of the cheek and upper jaw bones are rarely met with, except as the effect of gun-shot violence, or other great mechanical force applied directly to the face. Thus, the cheek-bone is sometimes fractured by the kick of a horse, or the blow of a hammer ; under these circumstances, there must be more or less splintering of the bone, and contusion, or even laceration of the soft parts.

Individuals sometimes attempt suicide by firing a pistol into the mouth. In such cases, the alveolar processes, with the teeth, are often forced away, together with the palatine processes of the upper maxillary bones, the palate bones, the lower turbinated bones, the vomer, and lateral portions of the ethmoid bone. The antrum is of course laid open. In one case, recorded by Dupuytren, the patient lived till the fortieth day ; and, after death, the cri-

briform plate of the ethmoid bone was found fractured, and a bullet lodged in one of the anterior lobes of the brain.

Treatment. All action of the muscles about the throat is to be suspended, and only liquid nourishment given with a spoon, or injected through an elastic gum catheter passed from the right nostril into the pharynx. Displaced portions of the palate are to be reduced; splinters of bone removed; and any injurious effects on the brain counteracted according to the rules delivered in my observations on injuries of the head. The soft parts are to be rectified as much as possible. Antiphlogistic remedies, inclusive of bleeding, will be indispensable.

SECTION III.

FRACTURES OF THE LOWER JAW-BONE.

Situation of fracture. Fractures of the lower jaw may take place in its *body*, its *rami*, the *coronoid process*, or the *neck* of one of its *condyles*.

A fracture sometimes occurs near the chin, though rarely in the precise situation of the symphysis; generally, at some point between the symphysis of the bone and the insertion of the masseter muscle. From this insertion, as far back as the angle of the jaw, or root of the coronoid process, the bone is covered externally by the masseter, and internally by the inter-

nal pterygoid muscle, a circumstance explaining the diminished frequency of fractures in this particular portion of the bone. It explains also another fact, which is, that when fractures do happen in this situation, they are not very liable to displacement, because the foregoing muscles antagonize one another. Fractures of the ramus are not very common, because this part is protected by the zygoma and masseter. *Fractures of the neck of the condyle* are more frequent than those of the *coronoid process*; and the condyle itself may then be drawn forwards and displaced by the action of the external pterygoid muscle.

In two places at once. The lower jaw-bone may be broken in two places at once, namely, on each side of the symphysis; and, in this case, it is difficult to keep the middle piece in its right situation, because several muscles concerned in depressing the jaw are attached to that part of it, and draw it downwards and backwards.

Vary in direction Fractures of the lower jaw may be *perpendicular*, *oblique*, or *transverse*, that is, parallel to the base of the bone. These last are less common than perpendicular and oblique fractures; but they are occasionally met with, detaching a portion of the alveolar process, with the teeth in it, from the rest of the bone.

Degree of displacement. When the *fracture is near the chin*, the bone be broken on one side or both, the

fragment, comprehending the symphysis, is drawn downwards and backwards towards the os-hyoïdes, by the action of the digastricus, mylo-hyoïdeus, genio-hyoïdeus, and genio-hyo-glossus. When the ramus is fractured, the fibres of the masseter and internal pterygoid, being attached to both pieces, prevent any considerable displacement.

Signs of. When a fracture of the lower jaw is accompanied by displacement, the nature of the accident is readily detected by the inequality in the line of the base of the *jaw*; by an irregularity in the arch of the teeth; by the inclination of the mouth to one side, more than the other; and by the crepitus, plainly distinguishable by manual examination. When the gums are lacerated, or the injured portion of the bone is exposed by a wound, as is often the case, forming a *compound fracture*, the nature of the accident is still more obvious. When the ramus, or the neck of one of the condyles, is broken, the patient will complain of severe pain in the ear; and when the jaw is moved, a crepitus is perceptible.

Treatment. The reduction of a fracture of the lower jaw is easily accomplished by means of the thumbs introduced within the mouth, and the fingers applied externally to the base of the bone. The surgeon is to draw the displaced fragment upwards, and a little forwards, so as to bring it on a level with that fragment which retains its proper situation. By attending to the line which the base of the jaw ought

to form, and the regularity or irregularity of the arch of the teeth, he may always judge of the correctness of the reduction.

Easy as the reduction is, the maintenance of it is sometimes troublesome, requiring that the arch of the teeth in the broken bone should be kept steadily applied to that of the teeth in the upper jaw. Hence, when the teeth are naturally irregular, or accidentally deficient, certain practitioners consider it advisable to introduce a piece of cork between such teeth as may be present, in order that there may be a smooth, even surface, against which the lower jaw may be confined. Others inclose the fractured part of the jaw with pasteboard, which, on its first application, is to be softened with warm water, so that it may adapt itself to the shape of the part. Whether pasteboard is used or not, the broken jaw is to be well supported, and kept steady with the four-tailed string bandage, the centre of which is to be put on the chin, and the front tails fastened over the occiput, and the posterior ones over the forehead. The assistance of a compress under the part that has a tendency to be drawn downwards and backwards, is frequently required. Mastication and conversation are to be avoided, as causing disturbance of the fracture. Hence only spoon victuals should be allowed. In bad compound cases, the administration of food and medicines through an elastic catheter is sometimes deemed advisable.

Fractures near the symphysis are very difficult to keep right, on account of the incessant disturbance of this part of the bone by the muscles attached to it and the os hyoides ; viz. the digastricus, mylo-hyoideus, genio-hyoideus, and genio-hyoglossus, all of which are put in action in deglutition. For this case, Mr. Lonsdale has invented a simple but ingenious instrument, which grasps the base of the jaw and the arch of the teeth, so as very effectually to maintain the reduction. Instruments, acting on a similar principle, have also been suggested by various surgeons both in France and Germany. They are not applicable to fractures of the ramus, coronoid process, or condyle.

When the neck of the condyle is broken, the condyle itself is drawn inwards and forwards by the action of the external pterygoid muscle ; and, as it cannot be replaced, we should keep the neck of the bone inclined towards it, by making the bandage act, particularly on the angle of the jaw, with the aid of a compress.

Cases are on record, in which the detached condyle, instead of uniting, was discharged from a subsequent abscess of the part.

Sanson asserts, that when the coronoid process is broken, the fracture never unites ; but that mastication is performed very well, the masseter and pterygoid muscles then fulfilling the office of the temporal.

Compound fractures of the lower jaw.

Compound fractures of the lower jaw are by no means uncommon ; and, when it is remembered that this bone can only be broken by blows, kicks, gunshot injury, and other species of direct external violence, the fact is sufficiently accounted for. The same explanation enables us to understand why the fracture is also, in many instances, *comminuted*, and several of the teeth knocked out, or loosened.

Treatment. The treatment of a compound fracture of the lower jaw consists in removing all loose splinters of bone ; reducing the fracture, if attended with displacement ; dressing the wound with simple emollient applications ; applying the four-tailed sling bandage to the jaw ; giving all food with a spoon in a liquid form, or, in very bad cases, through an elastic gum catheter, passed through the nostril into the pharynx ; enjoining perfect quietude of the part ; and adopting strict antiphlogistic treatment.

If abscesses form, an early opening should be made in them, and the mouth kept clean with a common gargle, or one containing the chloride of sodium. When necrosis takes place, the dead portions of bone should be removed, as soon as exfoliation has advanced far enough.

Complicated. Fractures of the lower jaw are sometimes *complicated* with laceration of the artery, or nerve, in the canalis mentalis. I have never seen an

instance, however, in which the bleeding did not soon stop, after the reduction of the fracture.

Recovery generally rapid. As the lower jaw is a particularly vascular bone, the repair of its accidental injuries is generally accomplished with surprising quickness. Hence, even the worst fractures of it, *compound* and *communited* ones, generally have a favourable termination. I have seen two or three horrible cases, in which nearly the whole of the lower jaw, and the integuments, and the muscles connected with it, and more or less of the tongue, were shot away; yet, the patients recovered, and in a more expeditious manner than might have been expected.

Cases of non-union. Instances are recorded, where fractures of the lower jaw continued ununited. In one case of this description, Dr. Physic, of New York, succeeded in bringing about the union of the bone, by passing a seton between the fragments.

CHAPTER II.

FRACTURES OF THE BONES OF THE TRUNK.

THE bones of the trunk, consisting of the ribs, sternum, vertebræ, and pelvis, are all occasionally exposed to fracture, giving rise to dangerous and often fatal results. The serious character of the injury in these cases, depends, however, upon the extent of mischief done to the viscera, which they protect; consequently they differ, in this particular, from fractures of the extremities. Injuries of the vertebræ, however, present features of so entirely a different character, that it will be more convenient to consider them in connection with injuries of the head, apart from common fractures.

SECTION I.

FRACTURES OF THE RIBS.

Frequency of the accident.

The ribs are broken almost as frequently as any bones which can be mentioned, except the clavicle and radius; the middle ones being those which are most exposed to the accident, and especially the part of them near what is termed their

angle. The upper ribs are rarely fractured, because they are protected in front by the clavicle, and covered by the pectoral muscles; while behind they are shielded, as it were, by the scapula and the thick muscles of the back. As for the lower ribs, they generally escape, in consequence of their being so short and moveable.

Degree and direction of displacement. The displacement of the fracture can only take place either inwards or outwards. On account of the connection of those ribs, which are usually broken, to the sternum in front, and to the vertebræ behind, there can evidently be no displacement in the direction either backwards or forwards. Neither can the ends of the fractured rib be thrown upwards or downwards, because the intercostal muscles, which are attached equally to both fragments, resist such an occurrence. However, the ends of the fracture may be forced inwards, or they may incline outwards; but, in by far the greater number of instances, the displacement happens in the direction inwards.

Signs of. The detection of a fracture of the ribs is not generally attended with difficulty; for, if we merely place our hand on the part that has been struck, and desire the patient to cough, we can mostly perceive a crepitus; or the natural movements of respiration will render the same symptom manifest, if we merely press our hand upon the injured part of the chest. When, however, the ribs are broken to-

wards their posterior ends, under the thick muscles of the back, we may experience a great deal more difficulty in detecting a crepitus. When one or more of the ribs are broken, the patient is annoyed with a sharp pricking pain in the situation of the injury, and has a frequent dry cough, which, by the disturbance of the fractured ends it occasions, gives considerable pain. Now, supposing we were not able to feel the crepitus, and the diagnosis were obscure, we should then act according to the wise maxim laid down by all the best writers on surgery; namely, adopt precisely the same treatment as if the occurrence of fracture were a matter of certainty.

Sometimes complicated. A simple fracture of one of the ribs, unattended with any particular complication, such as a wound of the lungs, emphysema, or effusion of blood in the chest, is not productive of any serious danger, and generally has a favourable termination. But, when several ribs are broken, the accident often has a fatal termination. The patient may die from extravasation of blood into the cavity of the chest, occasioned by the rupture of the intercostal arteries: this will produce *dyspncea*, from the formation of matter within the chest. On dissection, the matter will be found, with a clot of blood floating in it. He may die also from the point of the fractured rib puncturing the lungs and producing *emphysema*; an appearance, however, which often occurs, without producing any bad consequences; but when the

lungs are much lacerated, death ensues from inflammation and emphysema combined. A case has occurred, where the end of a broken rib punctured the spleen, and occasioned death. We hear continually of cases, in which several ribs are broken by the passage of carriages over the chest, and the fracture is complicated with injury of the thoracic viscera, effusion of blood in the thorax, or emphysema; the patient, in these cases, falls a victim to the effects produced.

Treatment. When the accident is free from the complications which have been specified, the right treatment is obvious. It is a rule, when a surgeon is called to a case of broken rib, always to bleed the patient freely in the first instance. This is done with the view of diminishing the risk of inflammation within the chest, and the chance of internal hemorrhage. Another indication is to keep the rib as free from motion as possible. We are to endeavour, therefore, to prevent the intercostal muscles from taking part in the performance of the function of respiration, and to make the patient breathe principally by means of the diaphragm and abdominal muscles. For this purpose we may apply a roller from seven to eight yards in length, and from four to six inches in breadth. It should be made of flannel cut from selvage to selvage, and applied as tightly as possible; and after two or three turns have been made, a piece of stiff

pasteboard should be placed upon the fractured ends, which will greatly assist in preventing the action of the intercostal muscles, the principal object to be attained. Or a strong napkin, the two ends of which must be brought from behind forwards, and then laced over the sternum. The patient is thus enabled, conveniently, to regulate the tightness of the bandage himself, and, for the sake of his own comfort, he will be sure to maintain the requisite degree of pressure; for, when the roller becomes too slack, he begins immediately to experience the prickling pain again, and his cough is more troublesome. It is evident, that whether we employ a broad roller, or a napkin, it would slip down towards the loins, if we were not to take the precaution to attach two pieces of tape to the central part of it near the spine, each of which is to be carried over the nearest shoulder, and sewed to a point of the bandage or napkin below the clavicle. The French apply another tape under the perineum, to prevent the roller from slipping upwards; but this would only be necessary in very corpulent subjects, and is rarely or never made use of in this country.

It sometimes happens, that the ribs upon both sides are fractured, causing great danger. No bandage ought to be applied in these cases, otherwise pressure will be made upon the lungs, and unpleasant symptoms produced. The chief dependence will be

in perfect quiet, and the antiphlogistic regimen, using purgatives, bleedings, &c.

Fractured ribs are generally treated with great success ; and, in four or five weeks, a firm union takes place. If the patient be left entirely to himself, without any kind of surgical assistance, a broken rib will also, for the most part, unite ; but in the Museum of the London University is a specimen of a fracture of six ribs, where the fragments are only connected by a fibrous or ligamentous substance. Without speaking positively, I should presume, that, in this example, no effectual means had been adopted to keep the ribs motionless during the treatment.

Fracture of the cartilages. In old persons, the cartilages of the ribs and the ensiform cartilage are frequently ossified ; and when they are in this state, they are liable to be broken. The ensiform cartilage has been known not merely to be fractured, but to be depressed, or beaten inwards, so as to lacerate the diaphragm, and tear the liver. The cartilages in their natural state may also be ruptured ; and when this happens, they do not unite by cartilage, but by osseous matter, a bony clasp being formed, by which the fragments are bound together. The treatment of the latter injuries is the same as that ordinarily adopted for fractures of the ribs.

SECTION II.

FRACTURES OF THE STERNUM.

Not frequent Fractures of the sternum are less frequent than might be expected, considering its exposed situation in front of the chest. For this fact there seem to be two reasons ; the first is, that the sternum is a spongy bone, less brittle than many others ; the second is, that it rests on the cartilages of the ribs, which form so elastic a support for it, that it is enabled to elude any common violence by the yielding of those parts.

Causes. However, notwithstanding these circumstances, it is sometimes broken, either by gunshot violence, or by the passage of a heavy carriage over the trunk, or by any other considerable force applied directly to the sternum. The fracture may also occur in another manner, which would not be expected. M. David, in his Mémoire sur les Contrecoups, relates a case, which took place in the following way : a bricklayer fell from the top of a house, and as he was falling, the middle of his back struck against a piece of timber, and the consequence of this blow was a fracture of the sternum. Now the explanation given by M. David of the mode in which the sternum happened to suffer injury, is, that it was broken by the violent action of the abdo-

minal muscles, diaphragm, and muscles of the neck, connected with this bone, whereby it was powerfully drawn at once in different directions. The truth of this account is confirmed by the curious fact, that the sternum is sometimes fractured during parturition by the violent efforts of the muscles attached to it; for cases of this kind are upon record.

Effects of it. A fracture of the sternum is not in itself dangerous; but it may be followed by severe and even fatal consequences, on account of the thoracic viscera happening to be injured at the same time; thus the lungs or the heart may be penetrated by a fragment of a broken sternum. In the Museum of the London University is a preparation, exhibiting a laceration of the right ventricle of the heart by a portion of fractured sternum. M. Sanson met with a similar case, in which the heart was torn by a sharp spicula of a broken sternum. Blood may also be copiously effused in the cellular membrane of the anterior mediastinum; and sometimes considerable inflammation of this texture will ensue, leading to the formation of abscesses, and to various degrees of necrosis in the injured bone. One occasional complication of the fracture of the sternum is *emphysema*, or an inflation of a great part, or of the whole, of the cellular membrane of the body, which can only take place, however, when a spicula of bone happens to wound the lungs.

Signs of. As the sternum is a superficial bone, its fractures are readily detected; if there be displacement, the lower portion is generally situated in front of the upper one, and sometimes overlaps it. In most instances a crepitus is perceptible, (produced by the motion of the fragments on one another in respiration,) and particularly obvious when the patient coughs, if the surgeon's hand be applied to the front of the chest. The patient, indeed, is usually teased with a frequent dry cough, and when the lungs have been pierced by a spicula of bone, there is a spitting of blood, which may be followed by emphysema. The cough is particularly annoying, from the motion and disturbance of the injured part, which it produces.

**Treatment if
there be no dis-
placement.** If there be no displacement or complication of the fracture, the principal indication will be to keep the fragments as quiet as possible in their present position; this is most effectually accomplished by applying a broad roller round the chest, and making it press on the broken bone and ribs, so as to limit and diminish their motion. The bandage should be rather tight, and kept from slipping down by passing a piece of tape over each shoulder, from the centre of the roller behind to a point in front of the chest. If the tapes were fastened too near the axillæ, they would slip off the shoulder, and not answer the purpose of their application. In order to keep the fragiments as quiet as possible, the

trunk should be inclined forwards, and the pelvis raised, so as to relax the abdominal muscles. Whenever the sternum is broken, another indication is to bleed the patient freely, because the risk of inflammation in the chest must be guarded against. Bleeding is also one of the most effectual means of relieving the cough, which always occasions severe pain, and a great deal of disturbance of the injured part. The lancet, antiphlogistic measures in general, especially quietude, the application of a broad bandage round the thorax, the relaxation of the recti abdominis, and the administration of an emulsion with a little opium, for the palliation of the cough, may be said to constitute the principal means of treatment.

Treatment of fracture with displacement. But, supposing the fracture were attended with displacement, some practitioners advise us to relax the abdominal muscles, asserting that we shall then more easily succeed in reducing the fracture by pressure; while others say it is best to extend the spine by putting a bolster under the loins, as they assure us, that, in this position of the patient the fragments can be more readily reduced. Now, if we were unable to effect a reduction by these or other plans, then the question would present itself whether we ought to perform an operation for the purpose of bringing about a coaptation of the bone? Whether we should be justified in making an incision down to the fracture, and trying to raise the depressed portion of bone to its proper level, by means of an

liable to produce fatal consequences, if there existed previously a probability of recovery.

The two os innominata may be broken together; but, more commonly, only one of them is broken. Most frequently, the fracture takes place in the upper expanded portion of bone, known under the name of the ilium, though sometimes it happens either in the ischium or os pubis. The solution of continuity may be limited to one part of the bone, or extend to several parts of it; and there may be a greater or lesser number of fragments, either with or without displacement. In many instances, in which the pelvis has been violently jambed between two bodies, or run over by a heavy carriage, the bones of the pelvis, besides being fractured, have even been dislocated.

Injury to the soft parts. From the manner in which these accidents usually happen, it is manifest, that the injury done to the bone is unfortunately not the most serious part of the mischief; the soft parts generally, and often the bladder or colon, being seriously injured. Sometimes the bladder or intestines are ruptured, sometimes blood is extravasated either in the abdomen or pelvis; and, in other instances, where the rami of the ischium and os pubis are broken, spiculae of bone may be driven into the bladder or urethra. A preparation in the Museum of the London University illustrates a case, in which there was a fracture of the ramus of the ischium, and one of the fragments tore the urethra; the urine escaped into the cellular sub-

stance of the perineum, and sloughing of those parts ensued. In gun-shot fractures of the pelvis, spiculae of bone may be forced completely into the bladder, and afterwards become the nuclei of calculous formations, so as to oblige the patient afterwards to submit to the operation of lithotomy.

Symptoms. When a fracture of the os innominatum occurs through the acetabulum, the head of the bone is drawn upwards, and the trochanter somewhat forwards; so that the leg is shortened, and the knee and foot turned inwards. Such a case may be readily mistaken for dislocation into the ischiatic notch. If the os innominatum is disjointed from the sacrum, and the pubes and ischium are broken, the limb is a slight degree shorter than the other; but in this case the knee and foot are turned outwards. Of the first of these accidents, I have seen two examples, of the latter only one. Extensive injuries of this kind are frequently accompanied also by extravasation of blood or urine;—deep seated ecchymosis;—injury of the kidneys;—complete loss of motion and sensation in one or both of the lower extremities;—discharge of blood or a black bilious matter, by vomiting or stool, either immediately or at more distant periods from that of the accident; painful tension of the abdomen from inflammation of the peritoneum and bowels; the formation of abscesses, which are sometimes of great extent;—and death.

Mode of detection.

These accidents are generally to be detected by a perceptible crepitus, on the motion of the thigh, if the hand be placed upon the crista of the ilium ; and they are attended with more motion than occurs in dislocations. When the fracture is very deeply seated, and limited to a single point of the ischium or pubis, so that no detached or moveable fragment has been produced, the exact nature of the case can rarely be made out with certainty before the patient's death, and the dissection of the parts.

Case A man was brought into St. Thomas's Hospital, in January 1791, on whom a hogshead of sugar had fallen. When examined, his right leg and foot were found inverted, and the limb appeared shorter than the left by two inches. Whilst making a gentle extension to endeavour to bring the injured limb to an equal length with the perfect extremity, a crepitus was discovered in the os innominatum. The patient was exceedingly pallid, his muscular power extremely feeble, and he appeared rapidly sinking. He expired the same evening. The following appearances presented themselves when the body was examined :—The deep part of the acetabulum was broken off, so as to allow of the escape of the head of the thigh bone from the cavity ; the neck of the bone was firmly embraced by the tendon of the obturator internus, and by the gemini; the

junction of the pubes at the symphysis had been separated, and the bones were nearly an inch apart; the ilium, ischium and pubes were fractured, and the fracture extended through the acetabulum; the left kidney was much injured, and about a pint of blood was found extravasated into the cavity of the abdomen.

Case In the second case, which also was in St. Thomas's Hospital, the appearances of a dislocation backwards existed. The patient died upon the fourth day after the receipt of the injury; and on examination after death, an extensive fracture of the innominatum was discovered, passing through the acetabulum and dividing it into three parts; the head of the os femoris was deeply sunk into the cavity of the pelvis.

Case The third case, in which the acetabulum escaped, was brought into Guy's Hospital in the year 1817, August the 8th. Mary Griffiths, aged thirty, had her pelvis caught between a cart wheel and a post;—when admitted into the hospital, she was pale, feeble, and her faeces passed off involuntarily. On grasping the right os innominatum a distinct motion and crepitus could be perceived, and the posterior superior spinous process projected much above its natural situation. The pubes appeared driven in towards the cavity of the pelvis. An extensive ecchymosis existed upon the right side below the last rib. The pelvis was fixed by a broad band-

age, and some opium was administered. She lived until the evening of the 24th, and appeared to sink from the effects of a large slough, which formed over the seat of extravasation upon the right side.

Examination. The body was inspected the next day, when an extensive fracture was found extending through the body of the pubes and the ramus of the ischium on the left side ; the right ilium was separated from the sacrum, at the sacro iliac symphysis, with a portion of the transverse processes of the sacrum, which were torn from the sacrum along with the ligaments ; the left sacro iliac junction had also given way, but only to a sufficient extent to admit the narrow extremity of the handle of the scalpel between the bones.

Fractures of the ilium generally favourable. I have known three cases of simple fracture of the innominatum recover.

Of these, two were fractures of the ilium, easily detected by the crepitus produced on moving the *cristæ ilii*. The third was a fracture at the junction of the ramus of the ischium and pubes. A circular roller was applied on the pelvis, in the two first cases, but not in the latter ; and the patients were bled freely. I have also known a compound fracture of this bone to recover ; but Mr. Hulbert, surgeon, sent me a compound fracture of the ilium, which had proved fatal.

When complicated with injury of the bladder, generally fatal.

Several cases of fracture of the pubes near its symphysis, accompanied with la-

ceration of the bladder, have also occurred within my knowledge, each of which proved fatal ; but when the bones have been broken without injury to the bladder, the patients have recovered. If the bladder be empty, it will escape injury ; but if it be in a state of distension, then rupture may ensue, and the degree of danger will be considerably greater, if the laceration occurs above the line of reflexion of the peritoneum ; as, in that case, the urine escapes into the peritoneal cavity, and excites general inflammation.

Treatment. When the pelvic viscera and urethra have escaped injury, a cure of the fracture may be effected by means of rest ;—a position in which all the muscles are relaxed ;—and a roller, or T bandage. Or, the patient may be placed on the double inclined plane ; a broad leather belt may be passed round the pelvis, and buckled firmly in front of it, and the feet secured to the foot board. We ought also to guard against inflammation of the pelvic viscera, by copious and repeated blood-letting. Any complaints, respecting the evacuation of fæces or urine, must also receive immediate attention ; if the bladder be ruptured or paralyzed, a catheter should be passed, to prevent the injurious (and sometimes fatal) effects resulting from extravasation. In these and similar cases, the employment of the late Sir James Earle's fracture-bed is attended with eminent advantage, as it enables the patient to empty

the bowels, without changing his position. Sometimes, notwithstanding the rigorous adoption of antiphlogistic measures, large abscesses form in the cavity of the pelvis; particularly, when there are detached splinters driven inwards. These collections of matter should be opened, as soon as a distinct fluctuation can be felt. The chief indications therefore in the treatment of fractures of the os innominatum are,—repose,—antiphlogistic treatment,—and attention to any particular symptoms which may arise.

SECTION IV.

FRACTURES OF THE SACRUM AND COCCYX.

The sacrum Fractures of the sacrum are, comparatively, of very rare occurrence; a fact attributable to its thickness, its spongy texture, and the advantageous manner in which it supports the weight and efforts of the whole body. The violence necessary to break this bone must be exceeding great; such, for example, as the fall of a very heavy body, or the passage of a carriage wheel over the convex surface of the bone, or a fall from a great height on that part. Accidents of this nature are highly dangerous, on account of the injuries with which they are generally complicated; thus, injury of the pelvic viscera generally, laceration of the rectum, injury of

the sacral nerves, and consequent paralysis of the rectum, bladder, and lower extremities, are the usual concomitants of this accident.

^{Degree of displacement} Fractures at the upper part of the sacrum are seldom attended with much displacement, on account of the thickness of the bone in that situation, unless the bone be smashed, and the fragments, at the same instant, driven inwards ; a case, which always implies severe injury of the soft parts, both external and internal. Fractures of the upper part of the bone, therefore, are not easily detected. When, however, the lower portion is fractured, being thinner, it is more easily displaced inwards, towards the rectum.

^{Treatment} In these cases, the principal indication is,—to combat inflammatory action by copious and repeated blood-lettings. Leeches should be applied to the vicinity of the sacrum, and the parts kept cool by the application of liquor plumbi acetatis. The rectum and bladder should be relieved from time to time. After the risk of inflammation has subsided, quietude is the most important point ; all that can be done is, to apply a roller round the pelvis, or a T bandage to the part, with or without a piece of soap plaster.

^{The coccyx} Fractures of the coccyx are still less frequent in their occurrence, partly, because it is less exposed to external violence ; and partly, because it eludes the effects of violence, owing to a certain de-

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grec of mobility which it possesses. But when it becomes ankylosed from age, a fall on the buttock, or a kick, may produce a fracture of this bone. This accident is easily known by the moveableness of the fragments, and the acute pain produced when the thighs are moved ; the fragments being then disturbed by the action of the glutæus maximus, the external sphincter, and coccygeus.

Treatment. Quietude is the principal indication. Refrain from walking, because it brings the glutæi into action. The patient should also refrain from lying on his back, or placing himself in a sitting posture. All formal attempts at reduction are useless, and injurious, on account of the irritable state of the soft parts.

CHAPTER III.

FRACTURES OF THE THIGH BONE.

FRACTURES of the thigh bone may be divided into three classes, according to the situation in which they occur.—First ; those which happen in the upper part, or neck of the bone.—Second ; fractures occurring in the middle third, or shaft of the bone.—And lastly ; fractures situated in the lower third of the shaft, or towards the condyles.

a. Fractures at the upper part of the thigh bone.

Mistaken for dislocation. These injuries have been frequently mistaken for dislocations of the hip, and are frequently distinguished with difficulty, not only from dislocations, but even from each other.

Three species of. Three species of fracture, differing in their nature and result, and requiring distinct modes of treatment, are met with at the upper part of the femur ; and these have been generally classed under the indiscriminate appellation of fracture of the cervix femoris. Want of proper anatomical investiga-

tion by dissection, has given rise to this confused classification, and led to much discussion respecting the processes which nature employs to effect a cure. Thus, whilst one surgeon declares that they cannot be united, another asserts that the cure is as easily performed as in fractures of other bones; which latter opinion is only true as far as regards two species of these fractures.

The opinions I am about to offer, are the result of extensive observations on living persons, who have suffered from these injuries; of numerous examinations of the dead body; and of many experiments which I have performed upon inferior animals, illustrative of this subject.

^{Of frequent occurrence} These accidents are of such frequent occurrence, that the wards of our hospitals are seldom without an example of them; whilst scarcely two cases of dislocation happen there in the course of the year, although the buildings contain about nine hundred patients.

^{The different species.} The different species of injury are, as we have already observed, three in number. First; that which takes place through the neck of the bone, entirely within the capsular ligament. Secondly; a fracture through the neck of the thigh bone at its junction with the trochanter major, external to the capsular ligament. Thirdly; fracture through the trochanter major, beyond its junction with the *cervix femoris*.

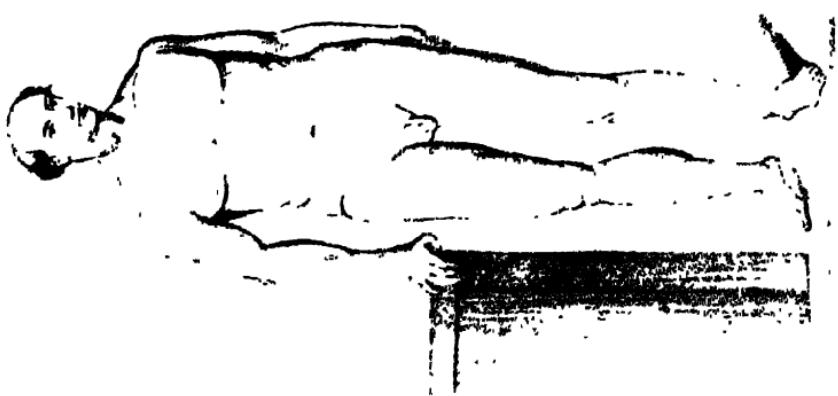
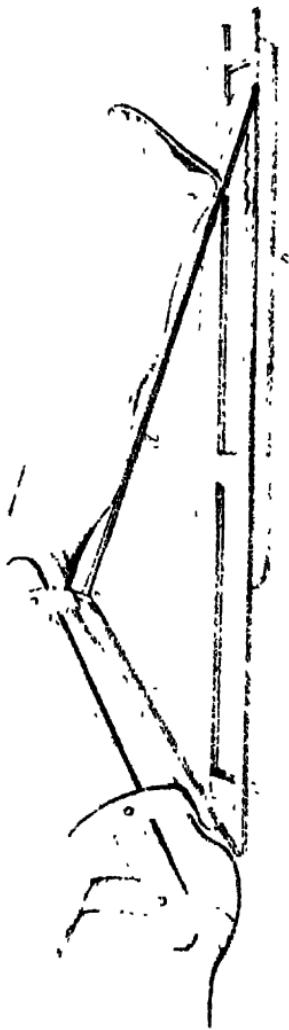


PLATE XVII.

FIG. 1. Fracture of the neck of the thigh bone. The leg is shorter; the knee turned out; the patella is from one to two inches above its fellow, sometimes more; the foot is generally everted, and does not reach the ground when the other leg is straight; the leg is easily drawn to the same length as its fellow, and then, if rotated, a crepitus is felt.

Fig. 2. The inclined plane for simple fracture of the thigh and trochanter major.

- a. The frame to rest upon the bed.
- b. Two lateral supports to a.
- c. The plane for the thigh.
- d. The plane for the leg.
- e. The joint.

SECTION I.

FRACTURE OF THE NECK OF THE THIGH BONE
WITHIN THE CAPSULAR LIGAMENT.

Signs of limb shortened Among the appearances usually produced by this fracture is, a shortening of the limbs to the extent of one or two inches. This arises from the connection between the head of the bone and the trochanter major being destroyed, so that the latter loses its support and is drawn up by the action of the glutei muscles, as far as the capsular ligament will admit of ; it therefore rests upon the edge of the acetabulum, and a little upon the ilium above it. This difference in length is readily detected by placing the patient in a recumbent posture and comparing the situation of the malleoli ; the heel of the injured extremity is usually found resting in the hollow between the internal malleolus and the tendo achillis of the sound limb ; but this is not always the case. A fork is sometimes formed in the trochanter minor, which catches the neck of the bone, and prevents a greater ascent than half an inch. Mr. Brooke informs me, that, in a case of oblique fracture of the cervix, which he dissected, the upper part of the bone prevented the ascent of the lower. On the other hand, when the fracture has happened for a length of time, and the patient has borne upon the injured limb, the ligament becomes extended, and the

leg is shortened four inches. In support of this Mr. Langstaff mentions the case of a man, aged eighty-two, in whom the heel was obliged to be elevated four inches, to make the bearings of the limbs equal. For a short period after the receipt of the injury, this shortening may easily be made to disappear by a very slight extension of the limb, but it reappears immediately that the extension is discontinued. This may be again and again effected, until the muscles acquire a fixed contraction, which cannot be subdued but by very great force.

^{Eversion of the}
^{limb} Another indication of this accident is—eversion of the knee and foot, from the action of the powerful and numerous rotators outwards, which have but very feeble opponents. The obturatores, gemini, pyriformis, quadratus, gluteus maximus, pectineus, and triceps, all assist in the rotation of the limb outwards; whilst only a part of the gluteus medius, the gluteus minimus, and the tensor vaginae femoris act as antagonist muscles, or rotators inwards. The eversion is by some considered as depending on the weight of the limb, and not upon the muscular contraction; but the resistance afforded by the rotators outwards, when an endeavour is made to turn the limb inwards, sufficiently proves the true cause of the eversion. The inversion is also in some degree prevented by that portion of the neck which remains attached to the trochanter major, and rests against the ilium.

Principal marks. The shortening of the limb, and the eversion of the knee and foot, are the two principal marks which attract the attention of the surgeon.

How distinguished from dislocation. When the femur is dislocated upwards, eversion of the knee and foot is prevented by the head and neck of the bone ; but the separation of these from the trochanter, in the case of fracture, allows of a ready eversion. This explains the reason why the foot is *inverted* in luxation, and everted in fracture. I have known the limb inverted in a case of fracture of the cervix femoris, but this must be regarded as an extremely rare circumstance.

Symptoms obscure at first. The nature of this injury is not well marked until some few hours after the receipt of the injury, as the muscles do not acquire a fixed contraction for some time ; it is from this circumstance that fractures have been mistaken for dislocation, and that the patients, even in the large hospitals, have been submitted to useless and painful attempts to reduce the displacement.

Degree of suffering. After the receipt of this injury, the patient suffers little or no pain whilst at rest in the recumbent posture, but rotation of the limb, more particularly inwards, creates much suffering from the fractured end of the bone rubbing upon the synovial membrane, which lines the capsular ligament. The pain is most acutely felt at the upper and inner part

of the thigh, near the insertion of the psoas and iliacus internus muscles, into the trochanter minor.

Freedom of motion. The limb can be moved in all directions, but the flexion creates more pain, and is accomplished with greater difficulty than extension, particularly if the thigh be directed towards the pubes ; if the knee be carried outwards when the thigh is flexed, it is accomplished with more ease, and without producing much pain.

Troch interma-
jor projects less. In this accident the trochanter major is drawn up towards the ilium, but the broken neck of the bone attached to the trochanter is placed nearer the spine of the ilium than the trochanter itself, in which situation it afterwards remains. This alteration of position makes the trochanter major of the injured side project less than that of the sound side, as it has lost the support of the neck, and rests in close apposition with the edge of the acetabulum. It is, consequently, much more concealed than usual, until the muscles waste from the duration of the injury, when it can be distinctly felt upon the dorsum ilii ; but there will be a greater or less projection of the trochanter, proportioned to the length of the fractured cervix attached to it.

Patient examin-
ed erect. To be perfectly satisfied of the nature of the injury, the patient should be examined in the erect as well as in the recumbent posture. He should be made to stand, which he can do with assistance,

and endeavour to bear his weight upon the sound extremity ; shortening of the injured limb is distinctly seen, the knee and foot are everted, and the prominence of the hip is lessened.

^{Pain on stand-} In attempting to rest upon the unsound limb, the patient experiences great pain in consequence of the stretching of the psoas, iliacus internus and obturator externus muscles, as well as by the pressure of the fractured portion of the cervix upon the capsular ligament.

^{Crepitus.} The fracture is not indicated by a crepitus, on motion whilst the patient is recumbent, as in other fractures, but it can generally be felt when the limb is extended to the original length and then rotated ; the crepitus may sometimes be discovered on the mere elongation of the extremity, but it is most distinct when rotation inwards is performed.

<sup>Most frequent
in females.</sup> Females are more liable to this accident than males ; we rarely, in our hospitals, observe it in men, but our wards are seldom without an example of it in the aged female. This may be accounted for by the powers of the constitution being generally weaker, and the natural position of the neck of the thigh bone more horizontal.

<sup>Age at which it
most frequently
occurs.</sup> The period of life at which this injury occurs, is another circumstance worthy of consideration ; as it seldom takes place but at an advanced period of life, whilst other fractures happen

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at all periods : hence the great confusion which has arisen with respect to the nature of this injury. We find it described as happening in young persons, but in these cases the injury has not been really confined to the cervix within the capsular ligament ; hence the confusion which has arisen with respect to the true character of the accident. During a period of forty years' attendance at St. Thomas's and Guy's Hospitals, and in my private practice, which has been more than my share, I have seen between two and three hundred cases of fracture of the cervix femoris ; yet I have known only two instances in persons under the age of fifty years. One was in a patient aged thirty-eight, who had an aneurism of the iliac artery ; and the other has been kindly shewn to me by that excellent anatomist, Mr. Herbert Mayo. It is most frequently met with between the ages of fifty and eighty, at a time of life when dislocation very rarely takes place. I have, however, seen a case of this fracture at the age of thirty-eight, and a case of dislocation at sixty-two.

Reasons for this liability at different ages The liability to the different forms of injury at the different periods of life, is owing to the changes which are taking place in the bones as well as in the other structures of the body, according to the balance of the arterial and absorbent systems. During youth, the action of the former preponderates, and hence the source of growth ; in middle age, the two preserve an equilibrium of action,

and thus but little alteration occurs ; in old age the absorbents exceed in activity the arteries, from which a diminution arises, but this is rather from a disease of power in the arteries than an increase in the absorbents.

^{Change in}
^{bones} Thus an increase of the bones takes place in youth, until they acquire that bulk, weight, and compactness which characterise them at the adult period ; this they for some time retain, until they become gradually light and soft in the advanced period of life. Even the neck of the thigh bone undergoes a considerable change from interstitial absorption, by which it becomes shortened, and altered in its angle with the shaft of the bone, the head often sinking beneath the level of the trochanter major, instead of being above it. This alteration gives the idea, upon a superficial inspection, of there having been formerly a fracture which had united.

^{Period of change}
^{varies} The period at which these alterations take place, vary in different individuals, as we find the general appearances do, which indicate old age, and which are as strongly marked in some at sixty, as in others at eighty years of age.

It is from these changes, however, that the nature of the injury varies generally at the different periods of life ; as, from the different states of the bones, that violence which would produce dislocation in the adult, occasions fracture in the old person ; and when dislocation does occur at an advanced period of life,

it is in those persons who have particularly strong constitutions, and in whom the bones have not undergone the changes I have described.

^{Causes very}
slight. The very slight causes which often occasion fracture of the bones in old persons, is a proof how much this altered state predisposes to such injury. The most frequent cause of the fracture of the neck of the thigh bone, in London, is a sudden slip from the foot to the carriage pavement, which, although only a fall of a few inches, is sufficient to produce this serious accident. It is also often occasioned by a slight fall upon the trochanter major; and I have known it produced by the toe catching in the carpet, or against some projection in the floor, at the time that the body was suddenly turned to one side. It is particularly necessary to recollect the very slight causes which give rise to this injury, and to be on your guard respecting it, otherwise it could hardly be supposed that an accident of so serious a nature could be so easily produced. I have dwelt particularly on the *slight* causes by which it is occasioned, that the young surgeon may be upon his guard respecting it, as he might otherwise believe that an injury of such importance could scarcely be the result of a slight accident, and that excessive violence is necessary to break the neck of the thigh bone. Such an opinion is as liable to be injurious to his reputation, as the error of confounding this accident with dislocation.

^{Opinions on}
^{mode of union.} With respect to the mode in which these fractures of the neck of the thigh bone within the capsular ligament unite, much difference of opinion exists. It is asserted by some surgeons, that these fractures unite like those occurring in the other bones of the body; but from the numerous dissections which I have had an opportunity of performing in these cases, I firmly believe that, as a general rule, the transverse fracture of the cervix within the capsule does not unite by bone. Such is the opinion I have delivered in my lectures for these thirty years, and which has been from year to year strengthened by further observations and fresh dissections. This is a most essential point, as it affects, in a material degree, the character of the surgeon. I was called to a case of this kind, in which the medical attendant had been promising, week after week, an union of the fracture, and the restoration of a sound and useful limb. After many weeks, the patient became anxious for further advice. I did all in my power to lessen the erroneous impression which had been made, by telling the patient she might ultimately walk, although with some lameness, and, taking the surgeon into another room, I asked him on what grounds he was led to suppose there would be union; to which he replied, he was not aware that the fracture of the neck of the thigh bone would not unite like those of other bones of the body. The case, however, proved

unfortunate for his character, as this patient did not recover in the usual degree.

Young medical men find it so much easier a task to speculate than to observe, that they are too apt to be pleased with some sweeping conjecture, which saves them the trouble of observing the process of nature, and they have afterwards, when they embark in their professional practice, not only every thing still to learn, but also to abandon those false impressions which hypothesis is sure to create. Nothing is known in our profession by guess; and I do not believe, that from the first dawn of medical science to the present moment, a single correct idea has ever emanated from conjecture. It is right, therefore, that those who are studying their profession, should be aware that there is no short road to knowledge, and that observations on the diseased living, examinations of the dead, and experiments upon living animals, are the only sources of true knowledge, and that inductions from these are the sole basis of legitimate theory.

Want of bony union In all the examinations which I have made of these cases, I have seen but one in which bony union had followed a transverse fracture of the neck of the bone within the capsular ligament. I do not however mean to deny the possibility of a bony union, or to maintain that it cannot take place, but it is an exceedingly rare occurrence. Considering the various modes in which a fracture may

take place, the degree of violence which may occasion it, and the extent of mischief to the surrounding parts, which may accompany it, it would be presumptuous in any one to maintain the impossibility of a bony junction. The bone may be broken without the fractured ends being separated from each other, or without any laceration of its periosteum or the reflected ligament which covers its neck ; and again, the fracture may be in part within, and in part without the capsular ligament ; under this latter circumstance, I well know that an ossific union might be produced, and I have had the opportunity of seeing more than one.

As a proof of the correctness of my position, I subjoin the following list of forty-three cases of fracture within the capsular ligament from different collections, not one of which had united by bone.

	Specimens
In the collection at St. Thomas's Hospital	7
In the College of Surgeons	1
In St. Bartholomew's Hospital	6
At Dublin	12
In Mr. Langstaff's collection	6
In Mr. Bell's and Mr. Shaw's	6
In Mr. Brookes's	2
In Dr. Monro's	2
In Mr. Mayo's	1

To these I have to add another, from an experiment upon a living animal, while upon the other side of the question, only a single instance, upon which the mind can for a moment dwell, has yet been produced; and in this case, the same appearances were found in both the thigh bones, and even these resembled what I have several times observed in the dead body, arising from a softened state of the bones.

Causes preventing bony union. I shall now point out several circumstances which, in my opinion, tend to prevent ossific union, after a transverse fracture of the neck of the thigh bone within the capsular ligament.

Want of apposition. In the first place, a want of proper apposition of the fractured extremities of the bone, may in many cases have considerable effect in preventing the union by ossific matter; as we find that a proper junction does not take place between the broken portions of bone in any part of the body, when the extremities are much separated from each other.

Case. In the case of a boy, from whom a portion of the tibia was removed in consequence of its protruding from compound fracture, but in whom the fibula remained uninjured, so that the ends of the divided tibia could not be brought into contact, no bony union took place.

Case. A case somewhat similar occurred in the Bristol Infirmary, under the care of Mr. Smith.

A portion of diseased tibia, between two and three inches in length, was removed, leaving a space to that extent between the ends of the bone; six weeks after the operation the boy was able to walk about without much difficulty, and it was supposed that ossific union had taken place. In consequence of his death from small pox, an opportunity occurred of examining the limb, when the larger part of the former space was found to be occupied by a thin ligamentous substance, without any bony deposit.

Experiments. This is also confirmed by experiments which I have made on other animals. I removed a portion of the radius, measuring seven-eighths of an inch in length, in a rabbit; the ends of the bone did not unite to each other, but formed connections with the ulna. In a second experiment, I removed a portion of the radius from another rabbit, measuring only one-ninth part of an inch, but with the same result. In a third experiment, a portion of the os calcis, being separated and drawn above its natural situation by the action of the gastrocnemius muscle, only united by ligament.

Motion of the part. In fracture of the cervix femoris, it is extremely difficult to keep the limb in a proper and steady position, as the most trifling change in position produces some motion of the part through the contraction of those powerful muscles that pass from the pelvis to the thigh. Were this, however, the only difficulty, it might possibly with much

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care and attention be in a great measure obviated.

Want of continued pressure. Even in those cases where the length of the limb is properly preserved, another circumstance may, I conceive, operate to prevent bony union ; and that is a want of pressure of one portion of bone upon the other, when the capsular ligament remains entire. This arises from the secretion of a large quantity of synovial fluid into the capsule, which distends the ligament, and prevents the proper contact of the broken bones. After the inflammatory process has subsided, and the effusion of ligamentous matter from the synovial membrane has taken place, this fluid becomes absorbed.

How prevented In other fractures, where the bones are surrounded by muscles, the broken extremities are kept pressed together by the action of these muscles ; but in the case of fracture taking place through the neck of the thigh bone, the muscles can only act upon one portion, and that in such a way as tends to separate one from the other.

Pressure essential. That pressure is essential to bony union, is proved by the examination of those cases in which the fractured ends of the bone overlap when a proper ossific deposit is found on that side where they press upon each other ; whilst on the opposite side, where no pressure exists, scarcely any alteration can be perceived. Again, in those cases where the actions of the muscles separate the fractured

ends of a bone, as we frequently find to be the case, union does not take place until the surgeon produces the necessary pressure by artificial means, as by the application of a belt, which buckles tightly round the limb.

Deficiency of
ossific inflamma-
tion. A third circumstance, however, which tends principally to explain the want of bony union in these cases, is the deficiency of ossific inflammation in the head of the bone, when separated from its cervix. In the perfect state, the head and neck of the femur are chiefly supplied with blood by the vessels of the cancelli of the cervix, and by those of the reflected membrane which covers it. If, therefore, the reflected membrane be torn through, which it generally will be in these cases, the chief source of supply to the head of the bone, and that portion of the neck connected with it, is cut off; it is then only supported by the vessels passing from the ligamentum teres, which are minute and few in number, and there is not sufficient organic power remaining to produce ossific matter. We find, therefore, that scarcely any change takes place in the head of the bone, similar to that occurring in other bones, when fractured; there is merely a layer of ligamentous substance thrown out, which covers the surface of the cancellated structure.

Dissection. On examining these injuries by dissection, we usually find the following appearances:—The head of the bone remains in the acetabulum

connected by the ligamentum teres. There are, upon the head of the bone, very small white spots, like ivory, covered by the articular cartilage. The cervix is sometimes broken directly transverse, at others, obliquely. The cancellated structure of the broken surface of the head of the bone, and of the cervix, is hollowed by the occasional pressure of the neck attached to the trochanter, and consequent absorption; and this surface becomes sometimes partially coated with a ligamentous deposit. The cancelli are rendered firm and smooth by friction, as we see in other bones which rub upon each other when their articular cartilages are absorbed, giving the surface the appearance of ivory. Portions of the head of the bone are broken off; and these are found, either attached by means of ligament, or floating loosely in the joint, covered by a ligamentous matter. They do not act as extraneous bodies, so as to excite inflammation, and produce their discharge, but rather resemble those loose portions of bone covered by cartilage, which are found so frequently in the knee, and sometimes in the hip and elbow joints. The most remarkable circumstance with respect to that part of the neck of the bone which remains attached to the trochanter major, is, that it is in a great degree absorbed, only a small portion of it remaining; its surface is yellow, and bearing the character of ivory, if the bones have rubbed against each other. I have seen some ossific deposition manifested

around this small remaining part of the neck of the bone, and upon the trochanter major, and thigh bone below it, in some examples of this fracture.

Capsular ligament thickened. The capsular ligament, inclosing the head and neck of the bone, becomes much thicker than natural. The synovial membrane, however, undergoes the greatest change, being very much thickened from inflammation, not only upon the capsular ligament, but also upon the reflected portion of that ligament upon the neck of the bone, as far as the edge of the fracture.

Increase of synovia. Within the articulation, a large quantity of serous synovia is found; by which term I mean to express, that the synovia is less mucilaginous, and contains more serum than usual. This fluid, by distending the ligament, separates, for a time, one portion of bone from the other; it is produced by the inflammatory process, and becomes absorbed when the irritation in the part subsides. I do not know the exact period at which this change takes place, but I have seen it in the recent state of the injury. A quantity of ligamentous matter is poured into this fluid, by the adhesive inflammation excited in the synovial membrane, flakes of which, proceeding from its internal surface, unite it to the edge of the head of the bone. Thus the cavity of the joint becomes distended, in part by an increased secretion of synovia, and in part by the solid effusion which the adhesive inflammation produces; the membrane reflected on

the cervix femoris is sometimes separated from the fractured portions, so as to form a band from the fractured edge of the cervix to that of the head of the bone ; bands also of ligamentous matter pass from the cancellated structure of the cervix to that of the head of the bone, serving to unite, by this flexible material, the one broken portion of bone with the other.

Ossific deposit on
the body of the
bone The trochanter is drawn up more or less in different accidents ; and in those cases in which it has been very much elevated, I have known a considerable ossific deposit take place upon the body of the thigh bone, between the trochanter major and the trochanter minor. When the bone has been macerated, its head is much lighter and more spongy than in the healthy state, excepting on those parts most exposed to friction, where it is rendered smooth by the attrition, which gives it a polished surface.

In most cases no
ossific union. It may therefore be considered as a general principle, that ossific union is not produced in these cases ; nature makes some efforts to effect it on that portion of the fracture attached to the body of the bone, but scarcely any upon the head and portion of the cervix separated with it. There are, however, two preparations in the Royal College of Surgeons in London, which have been sent as specimens of union by bone of the cervix femoris ; and as I may be thought prejudiced in favour of the opinion

I have advanced, I shall give that of an anatomist whose loss we have had lately to deplore. Mr. Wilson says, "*I have examined very attentively these two preparations, and cannot perceive one decisive proof in either, of the bones having been actually fractured.*"

Instance of non-union. This want of ossific union does not appear to be merely confined to fracture of the cervix femoris; it also occurs in fractures of the condyles of the os humeri, the coronoid process of the ulna, and other articular processes, when broken off entirely within the capsular ligament.

These opinions, which I have for many years delivered in my lectures, have been confirmed by many cases in which I have had an opportunity of dissecting the injured joint, and also by the result of experiments performed on other animals, and in which I found only a ligamentous union occur when the fracture was confined to within the capsular ligament.

Mr. Stanley's case. Mr. Stanley, for whom I have great respect, both as an anatomist and a surgeon, has met with the appearance of fracture in the neck of each thigh-bone, in the same subject. I do not mean to deny the possibility of the necks of both thigh-bones in this subject having been fractured, because that point can only be determined by the history of the accident, and by a very careful and accurate examination of several sections of the bones; but I can shew that similar effects are produced by disease.

Changes in the bone from age.

The neck of the thigh-bone in adult persons of middle age, has a close cancellated structure, with considerable thickness of the shell which covers it ; but in old subjects, the cancellated structure of the shaft of the bone, which is formed of a coarse net-work, loaded with adipose matter, is often extended into the neck of the bone, and the shell which covers it becomes so thin, that when a section is made through the middle of the head and cervix, it is found to be diaphanous ; of this I have several specimens. As the shell becomes thin, ossific matter is deposited on the upper side of the cervix, opposite the edge of the acetabulum, and often a similar portion at its lower part, and thus the strength of the bone is in some degree preserved ; this state may be frequently seen in very old persons. Mr. Steel, of Berkhamstead, (one of the most intelligent surgeons, and most respectable men I know,) gave me the thigh-bone of a person thus altered, whose age was ninety-three.

When the absorption of the neck proceeds faster than the deposit on its surface, the bone breaks from the slightest causes, and this deposit wears so much the appearance of an united fracture, that it might easily be mistaken for it. Before the bone thus alters, we sometimes meet with a remarkable buttress shooting up from the shaft of the bone into its head, giving it additional support to that which it receives from the deposit of bone upon its external surface.

But another change is also produced from disease, of which the following is the history, and which directly applies to the subject before us.

Sinking of the head of the bone, and absorption of the earthy matter. Old bed-ridden and fat persons (generally females) are often brought into our dissecting room with some of their bones broken (and more frequently the thigh-bone than any other) in being removed from the grave*. If the cervix femoris of such persons be examined, it will be found that the neck of the thigh-bone is shortened, so that its head is sunken down upon and in contact with the shaft of the bone opposite to the trochanter minor; the phosphate of lime is absorbed at that part where the ligament is inserted into the neck of the bone, and a ligamento-cartilaginous substance occupies its place, either extending entirely through the neck of the bone, or partially, so that one section exhibits signs of it, while in another it is wanting. The bone, in some cases, is so soft and fragile, both in its trochanter and head, that it will scarcely bear the slightest handling; and the motion of the thigh-bones in the acetabulum is almost entirely lost, so that the persons must have had little use of their lower extremities.

During the last winter we had two instances of this alteration in the neck of the bone, and it is an appearance which I have several times seen.

* This, of course, refers to a period prior to the passing of the Anatomy Act.

In examining the body of an old subject, very much loaded with fat, in the dissecting room of St. Thomas's Hospital, I found that the gentleman who had dissected one limb, had cut through the capsular ligament of the hip-joint, and tried to remove the head of the thigh bone from the acetabulum; but the neck of the bone broke on the employment of a very slight force, and upon a further trial to remove it, the bone crumbled under his fingers. As the other limb was not yet dissected, I requested Mr. South, one of our demonstrators, to remove, with care, the upper part of the other thigh bone; but although he used great caution in doing it, he could not remove the bone without fracturing the upper part of its shaft; he succeeded, however, in removing the upper part of the bone, so that it might be preserved.

We have here, then, a case in which the neck of the bone was absorbed, so that its head was brought in contact with the trochanter; in which, most decidedly, there had not been a fracture, although it had in some parts the appearance of one. In this case also, the disease occurred in each hip-joint.

Another case of the same kind was examined by Mr. South, during the last winter, which, so far as relates to the softened state of the upper part of the thigh-bone, was similar to the former; the heads were spongy, and the necks were shortened, so that there was scarcely any remaining; each trochanter was

light in weight, spongy, and very large ; lastly, there was little if any motion in either of the hip-joints, so that both limbs appeared, at first sight, as if dislocated upon the pubes.

But the best specimen of this state of the bone is the following, which I preserve with the most assiduous care, and value in the highest possible degree : —I have had for twenty years in the collection of St. Thomas's Hospital, the thigh-bone of an old person, in which the head of the bone had sunken towards its shaft. I have been in the habit of shewing this bone twice a year as a specimen of the manner in which bones sometimes become soft from age, disease, and the absorption of their phosphate of lime ; and I have frequently cut, with a penknife, both its head and its condyles, to shew this softened state. On sawing through its cervix, the cartilage, deprived of its phosphate of lime, had dried away in several parts, and the appearance was such that a person, ignorant of the change, would have declared it to be a fracture ; only, that in some sections the cartilage had taken different directions, and in some the bone was not yet entirely absorbed. We have also in the Museum of St. Thomas's Hospital, a skeleton in which both the thigh-bones, and each os humeri, are, in a subject extremely altered by rickets, divided by similar portions of cartilage, in which no ossific matter exists.

The plates which are appended will afford better

ideas of these morbid changes than words can convey; and I hope Mr. Stanley, also, will give plates of his preparations; *both*, however, should be engraved, as, without both, the public cannot form a correct opinion.

Experiments on animals. I have been led to prosecute the inquiry by experiments upon animals. I found it difficult to succeed in breaking the bone in the direction I wished, and, after a great number of experiments, was successful only in the following instances; the preparations of these I have preserved, and they may be seen in the museum at St. Thomas's Hospital.

Experiment I. The neck of the thigh-bone was fractured in a rabbit, on October 28th, 1818; and on December 1st, 1818, as the wound had been some time healed, I dissected the animal.

On dissection the capsular ligament was found to be much thickened; the head of the bone was entirely disunited from its neck, but adhered by a new ligamentous substance to the capsular ligament; the broken cervix, which was very much shortened, played on the head of the bone, and had smoothed it by attrition; the head of the thigh-bone had not undergone any ossific change.

Experiment II. The neck of the thigh-bone was broken in a dog, November 18th, 1818, and the animal was killed on the 14th of December following.

The trochanter, in this case, was much drawn up by the action of the muscles, so that the head and

cervix femoris were not in apposition. The capsular ligament was much thickened, and contained a large quantity of synovia.

The joint was lined with adhesive matter of a ligamentous appearance, which, adhering to the head of the bone, did not seem to be changed by any ossific process ; but the thigh-bone around the capsular ligament, the trochanter major, and the bone a little below it were enlarged.

Deductions. We find therefore by these dissections, that what appears in the human subject after this accident, takes place also in other animals ; and that motion, want of apposition and pressure, with little ossific action in the head of the bone, produce, under these circumstances, a deficiency of bony union, as in man.

The two preparations which I have preserved. were the only examples in which the experiment was complete in relation to the transverse fracture ; but I have two other interesting preparations derived from these experiments. I also made a great number of others, in which the fractures continued compound ; in each of these the head of the bone either became absorbed, or was discharged by ulceration ; and I never could succeed in uniting the head to the neck of the bone. I have since divided the neck of the thigh-bone in a dog, and the head of the bone was three-fourths absorbed. By way of contrast, I have also divided the bone externally to the capsule, in

five instances, and have preserved the bones ; the wounds united by adhesion, and every bone has been healed by ossific union ; the natural inference is, that fractures within the capsule, do not unite by bone, but that fractures external to it readily do so. As to the notion that the bearing upon the limb, or its weight, may have influence to prevent union in these animals, I have only to observe, that the muscles become contracted, the limb drawn up, and the animal cannot bear upon it for several weeks.

Mr. Brodie's experiment. My friend, Mr. Brodie, has furnished me with the following account of an experiment which he made upon the same subject, which fully confirms my observations. The tibia of a guinea-pig was broken at the lower end. A month afterwards the animal was killed. On dissection I found a fracture extending across the tibia, transversely, and so close to the ankle-joint, that it was situated at that part of the bone which is covered by the reflected layer of the synovial membrane. The synovial membrane itself, and the ligaments of the joint, appeared to have been very little injured, and the broken surfaces had remained in good apposition ; nevertheless, there was not the smallest union of them, either by bone or ligament, and there had been no formation of callus round the fracture. The bone in the neighbourhood of the fracture had become compact and hard, in consequence of the ossification of the medullary membrane lining the cancelli.

Mr. Burns's experiment. Professor Burns, of Glasgow, has had the great kindness to send me the following observations :—“ Permit me to offer my warmest thanks for the pleasure and edification I have received from the study of your late work. I was early led to attend to the process adopted by nature in forming a new articulation in injuries to the hip-joint, by the dissection of a dog which I had when a boy, and which had the hip fractured. Many years afterwards I examined the parts, and found the fragment of the cervix belonging to the head absorbed, the head itself filling the acetabulum ; the shaft of the bone expanded, and a new head formed for a new socket, and the whole enveloped in a dense capsule or covering.

“ In a fracture of the *os femoris* external to the capsule, the *gluteus medius* and *minimus* seem to act as a cushion to stop the ascent of the end of the cervix, whilst the fragment attached to its head will, perhaps, afford some opposition ; but in the fracture within the capsule, the end of the cervix is drawn more freely up under the *gluteus medius*, and lodged behind the inferior spinous process of the ilium.

“ Is this the explanation of the greater shortening in the one fracture than in the other ?

“ Nothing can better explain the want of ossific union than the principle you have laid down.”

Union of fracture partly within and partly external to the capsule.

Having by experiment ascertained the circumstances I have mentioned, I was

next anxious to learn if the head and neck of the thigh-bone would unite under a longitudinal fracture, in part within and in part external to the capsular ligament, in which apposition, contact, and pressure are maintained ; and for this purpose I made the following experiment.

Experiment III. I divided the head, neck, and a portion of the trochanter major of the thigh-bone of a dog longitudinally, by placing a knife on the trochanter major, and striking it down towards the acetabulum through the head of the bone. The animal was killed twenty-nine days after, and the following appearances presented themselves :—

A portion of the trochanter major had been broken off, and was only united by cartilage. The head and neck of the bone, which had been longitudinally broken, were united ; the neck by a larger quantity of ossific deposit than that which joined the separated portions of the head of the bone, and so irregularly as to make a beautiful preparation, and shew the circumstance most clearly. This bone may be seen in the collection at Saint Thomas's Hospital.

Whether the union began in the fracture externally to the ligament, and proceeded inwards, or whether on the whole surface at once, it is impossible to ascertain ; but the coalescence was firm, though, as I have stated, I thought more so at the neck than at the head of the bone. The union in this case is readily explained. Apposition was sup-

ported ; the vessels of the head of the bone and cervix remained whole ; and, therefore, this experiment shews at once why the longitudinal fracture unites, and the transverse, in general, does not.

Union of these bones. Thus then it appears, that in a longitudinal fracture of the head and neck of the bone in part external to the ligament, if the bones be applied to each other, pressed together, and in a state of rest, and the vessels remain, ossific union can be produced ; although the ossific deposition is extremely slight when compared with that of other bones.

Confounded with dislocations. The cases of fracture of the cervix femoris may be confounded with those dislocations of the hip in which the limb is shortened ; viz. those occurring on the dorsum ilii, the ischiatic notch, and on the pubes. The eversion of the knee and foot, with the greater mobility of the limb, will distinguish them from the two former ; and in the latter instance, the readiness with which the head of the bone can be felt in the groin, renders the case sufficiently obvious.

With other fractures. They may be also confounded with cases of fracture external to the capsular ligament ; but if the surgeon be sufficiently attentive to the following points, he will readily distinguish the difference. The age of the patient, the length of the limb, the cause of the injury, the feeling of crepitus, the great extravasation of blood, and the degree of suffering ; for fracture of the cervix generally occurs at an

advanced age; the limb is shortened, the cause of the injury very slight, there is not any perception of crepitus until the limb be elongated, and the degree of suffering is very trivial.

Various modes of treatment. In the treatment of the fractures of the neck of the thigh bone, within the capsular ligament, I have tried numerous and various means, to endeavour to effect a bony union, and I have known other surgeons adopt many ingenious plans with the same view, but all without success.

First method. One mode has consisted in placing the fractured limb over a double inclined plane, by which a regular and constant extension is preserved, and which, by raising the planes at the knee, may be increased to any degree that the surgeon may require, or the patient can bear. At the same time, a bandage is applied around the pelvis and upper part of the thigh, to bring the neck of the bone, as much as possible in approximation with the head from which it has been separated; and this extension with pressure, has been steadily preserved for three months. With respect to the patient's body, it has been placed at an angle of forty-five degrees.

Second method. A second method has consisted in placing a board at the foot of the bed, upon which the foot of the sound limb is rested, so as to prevent the descent of the body in the bed; the other limb is then extended as much as possible, and a weight, appended to the foot, is suffered to hang through a

hole in the board over the end of the bed, in order to support the extension with regularity and steadiness for several weeks.

Third method. In a third method, the patient has been placed in bed with both limbs extended to the utmost possible degree, and then the two feet have been bound together by a roller, passed from the foot on the injured side under the sound foot, so as to make one limb steadily preserve the extension of the other. Or this may be effected by an iron plate affixed to the shoe on the sound foot, with a screw passed through a hole in the plate, and having a band fixed to the other foot, which may be tightened by turning the screw, and the foot, by this means, be kept constantly extended.

Fourth method. A fourth mode employed for this purpose has been the application of Boyer's splint, with the intention of extending the limb from the pelvis; but this splint, though it answers well for fractures of the thigh under ordinary circumstances, has a tendency to prevent union in those fractures which occur at the upper part of the bone, by the pressure of its band upon the inner and upper portion of the thigh.

Mr. Hagedorn's plan. Mr. Hagedorn has recommended a machine for fractures of the neck of the thigh bone, which is very ingenious in its construction. It consists of a long splint to extend from the hip to the foot, and which is to be firmly applied, by means of

proper straps, to the sound limb; at the bottom of this is fixed a broad foot-board, perforated with a sufficient number of openings to receive the bands, by means of which both feet are to be securely fixed to it; these bandages are attached to a kind of leathern gaiter, made to lace tight round the ankle, and the upper part of the splint is kept close to the hip by means of a broad bandage carried round the pelvis. By this machine the extension of the limb is tolerably well effected, so long as the patient can be kept still; but a displacement of the bones will invariably be the consequence of every motion which the evacuation of the fæces will necessarily require. I am never so wedded to any opinion as to be prevented from trying, or from wishing others to employ, every means which appear plausible or ingenious; and, therefore, I think that this instrument ought to have a fair trial.

Mr. Earle's
plan. Mr. Earle is of opinion, that these cases may be cured by long continued attention in keeping the parts at perfect rest. I think a trial should be made of the bed recommended by Mr. Earle, and heartily wish him success in his laudable attempt to prevent the lameness and shortening of the limb in cases of fracture within the capsule, which has invariably been the result in those cases I have had an opportunity of witnessing.

But all the means which I have seen used have been found unavailing. I have been baffled at every

attempt to cure, and have not yet witnessed one single example of union in this fracture. I know that some persons still believe in the possibility of this union, by surgical treatment, and that instances of success have been published ; but I cannot give credence to such cases until I see that the authors were aware of the distinction between fractures within and external to the articulation, and that they are likewise acquainted with those changes in the head and neck of the bone, which occur in advanced age.

The following anecdote was related to me by an intelligent surgeon, who had been attending an hospital on the continent for some time. One of the surgeons belonging to it observed, " Some of the English surgeons do not believe that we unite fractures of the neck of the thigh bone ; now there is one you shall examine, as the patient is dying." A few days after, the patient died, and the joint was examined, when the bone was found still disunited. The surgeon of the hospital only made a significant shrug of disappointment.

Cases where union might occur. The cases in which union might be produced are two ; one, in which the periosteum, covering the neck of the thigh bone, is not torn through, a circumstance which now and then happens ; the other, in which the head of the bone is broken, so that the cervix still remains in the acetabulum : but in neither of these cases will the limb

exhibit the shortened state which the fracture of the neck of the bone usually produces, and, therefore, the common characters of the accident will be wanting. Even in such cases, I would prefer a ligamentous union, to the confinement and danger of bony union, in regard to the health and life of the person, and, as I believe, to the subsequent use of the joint.

Treatment recommended. Not having found or known any mode of treatment succeed in effecting an ossific union in these cases, and having repeatedly seen the patient's health much injured by the trials which have been made, all that I now direct to be done, is, that a pillow should be placed under the limb for its whole length, and a second, rolled up, put under the knee, and that the limb should be allowed to remain upon these for ten days or a fortnight, until pain and inflammation have subsided ; the patient should then be allowed to rise and sit in a high chair, to prevent much flexion of the limb, which would be painful. In a few days more he should begin to walk with crutches, and after a time a stick should be substituted for the crutches, and in a few months he will be able to use the limb without any adventitious support ; when he commences to bear the weight of the body on the limb, he should be provided with a high heeled shoe, which will much assist him.

Degree of recovery. The period and degree of recovery in these cases, depend much upon the bulk of the pa-

tient; as the very corpulent patient will, for a long time, require the aid of crutches; in others less bulky, a stick only will be required, and in very spare persons such assistance is only necessary for a very short period; but unless a shoe be worn having a sole sufficiently thick to remedy the diminished length of the limb, the patient has a considerable degree of lameness.

In doubtful cases. Should any doubt exist as to the fracture being situated external or internal to the capsular ligament, the case should be treated as for the former injury, which I shall presently describe, and in which ossific union may be procured.

A cautious opinion necessary. The surgeon should be very cautious in the opinion he gives respecting the result of these injuries, as when the fracture is transverse, lameness is certain to follow; but in various degrees, which cannot at first be estimated.

Sometimes fatal. In very aged and infirm persons, this accident sometimes produces fatal consequences, from the exhausted state of the constitution, and from the confinement in the attempts at union.

SECTION II.

FRACTURES OF THE CERVIX FEMORIS, EXTERNAL
TO THE CAPSULAR LIGAMENT.

Difficult to distinguish. The symptoms produced by this injury are, in many points, so similar to those accompanying the former injury, that great attention is necessary to distinguish them. Such a distinction is, however, highly important, as the result differs so materially ; an ossific union being readily produced when the injury is external to the capsular ligament, whereas, in that which I have already described, such a union rarely if ever takes place.

Signs of. When the fracture occurs external to the ligament, the injured limb is shorter than the other by from half to three quarters of an inch ; the foot and knee are everted ; the rotundity of the hip is lost ; and the patient experiences much pain at the hip, and about the upper and inner part of the thigh.

These marks are also found when the fracture takes place internal to the capsular ligament.

Diagnosis. The following are the principal signs by which the nature of these injuries may be detected. First, the fracture external to the capsule occurs frequently at an earlier period of life than that which takes place internal to the joint ; it usually occurs under fifty years of age, although I have

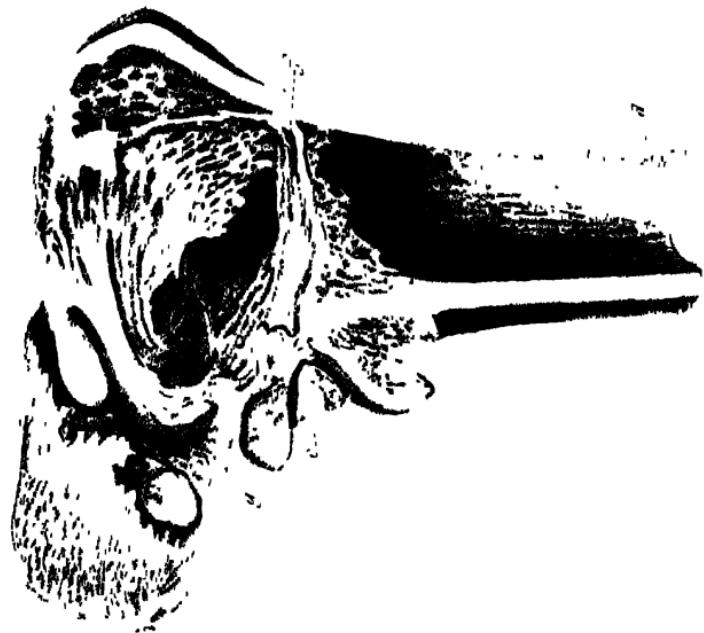


PLATE XVIII.

FIG. 1. The head of the thigh bone, the neck of the bone absorbed and shortened, so that the head and trochanter are in contact.

- a. The head of the bone.
- b. The trochanter major.
- c. Shaft of the bone.
- d. Ligament attached to the remains of the cervix.

Fig. 2. From a preparation in Mr. Langstaff's museum; showing non-union of the cervix femoris within the capsular ligament, and perfect union external to it.

- a. The head of the thigh bone.
- b. The trochanter major.
- c. The trochanter minor.
- d. The shaft of the bone.
- e. The ligamentum teres in its usual situation.
- f. Fracture of the thigh bone external to the capsule, firmly and well united by bone.
- g. Fracture of the cervix within the capsule, still remaining united even by ligament.

EXPLANATION OF PLATE XVIII.

Fig. 3. Ligamentous union of the neck of the thigh bone.

- a.* The ilium.
- b.* The pubis.
- c.* The ischium.
- d.* The foramen ovale.
- e.* The os femoris.
- f.* The trochanter major.
- g.* The trochanter minor.
- h.* The neck of the thigh bone, fractured within the capsule, and to a great extent absorbed. Its surface is smooth and rounded, so as to roll upon the hollow of the head of the bone.
- i.* The head of the bone hanging in the acetabulum by ligament alone; smooth from continual friction, and partially covered by ligament.
- k k.* The capsular ligament very much thickened, more especially opposite to the foramen ovale.

known it to be produced after that age, when it usually proves fatal. Several of these cases which have fallen under my notice have occurred under that period; and therefore, a surgeon, called to the bedside of a patient who has an injury of the upper part of the thigh bone, if he finds the age of the patient to be under fifty years, will, with very few exceptions, be warranted in pronouncing it either a fracture just external to the ligament, or one through the trochanter major.

Second. The injury is generally occasioned by much greater violence, as by severe blows or falls, or the passage of laden carriages over the pelvis, whereas the internal fracture is the consequence usually of very slight cause.

Third. The crepitus in the fracture external to the ligament, is readily felt when the limb is slightly moved, and generally without drawing it down.

Fourth. The degree of suffering is much greater, especially on moving the limb, if the injury be external to the capsule; as the rough extremity of the bone penetrates the surrounding muscles. The limb also is much more swollen, and the constitutional irritation is considerable.

Fifth. There is generally great extravasation of blood in these cases; and many months elapse before the patient recovers the use of his limb.

Dissection of. In dissecting these cases, the fracture is generally found at the root of the neck of the bone,

external to the capsular ligament ; but its seat and extent vary very much in different examples, and the degree of shortening of the limb, depends upon the form of the fracture, and upon the extent of laceration of the surrounding soft parts, so as to admit of retraction. Sometimes, fracture external to the capsular ligament is complicated with injury of the trochanters.

Case Mr. Travers has an excellent specimen of this form of injury taken from a patient who was under his care in St. Thomas's Hospital.

Richard Norton, aged sixty, was admitted into the Hospital on the 24th of January, 1818, in consequence of severe injury of his left hip, occasioned by a fall upon the curb stone of the foot pavement. The limb of the injured side was shortened, and the knee and foot everted ; the swelling about the hip was very great ; the limb could be moved freely in all directions, but not without creating much suffering ; and when moved, a crepitus could be distinctly felt in the situation of the trochanter major. When the swelling had in a great measure subsided, the limb was confined by the application of the long outer splint, and two thigh splints well bedded. In March the splints were removed, when the limb was found to be a little shortened, but the hip had regained its natural appearance. About a month after this, he began to use his limb, walking with the aid of crutches. He was afterwards placed under the

care of the physician, on account of his general health being defective, and he died suddenly, being seized with spasms in his chest.

Dissection. On examining the hip after his death, the fracture was found to have extended through the trochanter, some way down the bone, and it had apparently united with very slight deformity, but on macerating the bone, the head and neck became loose on the body of the femur ; they could not, however, be perfectly separated, as a shell of bone had formed, confining the head and cervix.

The preparation which Mr. Travers was so kind as to send me, presents the following appearances. The head and cervix of the bone had been separated from the trochanter major and body of the femur ; the upper part of the bone had been obliquely split, so as to receive the cervix into its cancelli. This fracture had divided the posterior portion of the trochanter major from the body of the thigh bone, and the trochanter minor had been removed with it. Union had taken place between the fractured portions of the trochanter, at a slight distance from each other, and thus a hollow was left into which the cervix femoris was received, but it had not been united by ossific deposit, as it became loose from the maceration.

Mr. Oldnow's cases. Mr. Oldnow, of Nottingham, sent me two specimens of this fracture, in which the necks of the bones were fractured at their junctions with

the trochanter major. The trochanter major itself had been broken off, and the trochanter minor formed a distinct fracture. The bones had become re-united, the cervix femoris to the shaft of the bone, and the trochanter minor a little higher than its natural attachment. The trochanter major was in one specimen re-united to the body of the bone, but not in the other. Thus the thigh bone was at its upper part divided into four parts; the head and neck of the bone formed one part; the trochanter major a second; the trochanter minor a third, and the body of the bone the fourth. The union was accompanied by very little shortening of the thigh.

^{It unites by}
^{bone.} This fracture, therefore, unites by bone in a similar manner to the fracture of other bones external to the capsular ligaments; because the bones can be brought into apposition, and are confined together by the surrounding muscles, and the nutrition of each extremity of the bone is well supported by the vessels which proceed to it from the surrounding parts.

^{Difference of}
^{opinion account-}
^{ed for.} This, in some measure, explains the difference of opinion, respecting the union of the fracture of the neck of the thigh bone. In the internal fracture, the bones are not applied to each other, and the nutrition of the head of the bone being imperfect, no ossific deposit is produced. But in the external injury, the ends of the bone are held together by the pressure of the surrounding

soft parts, and are easily kept in apposition by external bandages and splints. Generally a long period is required to produce a perfect union in these cases, many months elapsing before the patient acquires a free use of the limb; and the neck of the bone, received into the cancelli, moves for a long period in its new situation; although it is so far locked in as to prevent its separation.

Treatment. In the treatment of this injury, the principle is to keep the bones in approximation by pressing the trochanter towards the acetabulum; and the length of the limb is preserved by applying a roller around the foot of the injured leg, and by binding the feet and the ankles firmly together, so as to prevent their retraction, and thus cause the uninjured side to serve as the splint to that which is fractured, giving it a continued support. A broad leathern strap should also be buckled around the pelvis, including the trochanter major, to press the fractured portions of the bone firmly together, and the best position for the limb is, to keep it in a straight line with the body.

The following plan I have also known successful : —The patient being placed on a mattress on his back, the thigh is to be brought over a double inclined plane composed of three boards, one below which is to reach from the tuberosity of the ischium to the patient's heel, and the two others having a

joint in the middle by which the knee may be raised or depressed ; a few holes should be made in the board, admitting a peg, which prevents any change in the elevation of the limb but that which the surgeon directs ; over these a pillow must be thrown, to place the patient in as easy a position as possible *.

When the limb has been thus extended, a long splint is placed upon the outer side of the thigh to reach above the trochanter major, and to the upper part of this is fixed a strong leathern strap, which buckles around the pelvis, so as to press one portion of bone upon the other ; and the lower part of the splint is fixed with a strap around the knee to prevent its position from being altered ; the limb must be kept as steady as possible for many weeks, and the patient may be permitted to rise from his bed when the attempt does not give him much pain ; he is still to retain the strap which I have mentioned round the pelvis ; and by this treatment he will ultimately recover with an useful though shortened limb.

* The construction of this inclined plane is so little complicated, that it may be made at the instant of two common boards, one of which is to be sawn through, nearly at the middle, and if hinges cannot be immediately procured, the boards may be nailed together thus .

SECTION III.

FRACTURE THROUGH THE TROCHANTER MAJOR.

Nature of. An oblique fracture sometimes occurs through the trochanter major, without any injury to the cervix of the thigh bone. This accident takes place at all periods of life, and its symptoms are as follow.

Signs of. The limb is but little shortened, and sometimes its length is not altered; the foot is generally benumbed; in some cases the patient cannot turn himself in bed without assistance, and any attempt to do so creates excessive pain. The portion of the trochanter connected to the shaft of the bone, is either drawn forwards towards the ilium, or it falls towards the tuberosity of the ischium; being, in general, widely separated from the superior portion, or that which remains connected to the neck of the bone. The foot is greatly everted, and the patient is unable to sit on account of the violent pain produced by the position. From the separation of the fractured extremities of the bone, crepitus cannot often be detected, unless the limb be very freely moved.

Diagnostic signs. A fixed state of the upper part of the trochanter, whilst its lower part obeys the motion of the thigh bone; eversion of the foot; an altered position of the trochanter major; crepitus under

very extended motion of the upper part of the limb, and little diminution of its length, are the chief distinguishing marks of this injury.

But when the fracture happens below the insertion of the principal rotatory muscles, the lower portion of bone is much raised by the action of the glutæus maximus, and the limb becomes very much shortened and deformed, at the place of union, by exuberant callus.

Unite by bone. Ossific union readily takes place in these cases, more quickly than in the fracture through the cervix femoris, and the patient recovers a very good use of the limb.

Case. The first case which I recollect seeing of this injury, was, about the year 1786, in St. Thomas's Hospital, under the care of Mr. Cline. The limb was extended over a pillow, rolled under the knee, and splints were applied on each side of the limb; a firm union took place, and the man was able to walk extremely well. After being dismissed from the hospital, he was attacked with fever, of which he died. On examining the seat of injury after death, the fracture which had extended through the trochanter major, was found firmly united with very little deformity.

The following are the particulars of a case which I attended with Mr. Harris, of Reading.

Case. July 20th, 1821, Mr. B., aged 51, a gentleman residing about six miles from Reading,

fell from his horse, and injured his left hip ; he got up immediately, and walked a few steps, but soon found that he was incapable of bringing his left leg forward, and he felt a severe pain in the hip. He was conveyed home in a cart, a distance of about four miles, and Mr. Harris visited him about two hours after the accident, when the following circumstances were noticed. He could not discover any crepitus on rotating the limb ; it was of equal length with the sound one ; the foot was not turned inwards or outwards, and the patient could retain it in any position in which it was placed. A good deal of swelling existed about the hip, and Mr. B. complained of some pain ; he could bear the limb to be moved without much increase of suffering, excepting when the injured limb was drawn across the sound one, when the pain was greatly augmented. Under these circumstances, Mr. Harris gave it as his opinion, that there was neither fracture nor dislocation.

On the 22nd, Mr. Ring, of Reading, saw Mr. B., and on examining the limb, confirmed the opinion of Mr. Harris.

The patient was kept at rest, and leeches, with evaporating lotions, were employed to reduce the swelling of the hip.

On the 26th, an acute attack of hepatitis, rendered active treatment necessary ; and, during this time, the limb remained much in the same state.

August 14. Mr. Ring again examined the limb,

and whilst moving it, thought he felt a crepitus. On the following day, Mr. Harris also felt and heard the crepitus.

The case being, however, still obscure, Mr. Brodie was sent for. On his arrival, the particulars of the case were communicated to him, and he minutely examined the injured limb, but for some time was doubtful as to there being a fracture, until, upon rotating the limb very extensively, he distinctly felt the crepitus. He was, however, much surprised to see, that the patient could, when standing, bear very considerably upon the injured limb, and he considered the case as very obscure, the usual symptoms of fracture, except the inability to move the limb, being but little marked or entirely wanting.

Mr. Brodie applied a long splint, with a bandage from the toes to the hip, which he directed to be worn for a month; and at the same time ordered the limb to be kept perfectly at rest.

But little alteration having taken place in the case at the end of the month, I was requested to visit Mr. B., and after hearing the history of the case, proceeded to examine the limb. First, looking to the relative position of the extremities, as the patient lay upon his back, I placed my hand under the trochanter major, which I found had dropped from its natural situation, and, raising it toward the cervix, readily detected the crepitus. I therefore agreed with Mr. Brodie, and Mr. Harris, as to the nature

of the injury, viz., a fracture of the cervix femoris, where it unites with the trochanter major; and recommended the following plan of treatment, with a view of retaining the trochanter in its proper position, whilst the patient could remain perfectly at rest in the horizontal posture.

A mattress was made of horse hair, about five inches thick, very smooth, and this was covered with a sheet. A part of the mattress was made to draw out on the opposite side to the fracture, so that when the natural evacuations took place, there still should be no motion of the body. Before drawing out the piece of mattress, a board of two feet long and six inches wide, shaped like a wedge, was insinuated under the buttock of the right side, the two ends of the board resting on the mattress, thereby preventing the nates from sinking, at all, into the opening, when the piece of mattress was removed: the board was of course taken away, when the portion of the mattress was replaced. Upon the bedstead was first placed a thick smooth board, sufficiently large to cover the bottom of the bed, and on that was placed the mattress, thereby preventing any sinking by the weight of the body.

A bandage, made in the following manner, was applied to support the trochanter.—A broad web, sufficient to go round the body, over the hip, was furnished with two straps and buckles to fix it with, and the belt was made of a greater width at that

part, which was to be placed under the injured trochanter; the whole was lined with chamois leather, and stuffed. A pad of the same leather was made, about six inches long, three broad, and three thick, gradually tapering to a point; this pad was placed immediately under the injured trochanter, so that when the bandage was buckled on, it passed into the hollow beneath that process, forcing it upwards and forwards into its natural position. Another thick pad, about eight inches square, of a wedge shape, was provided, and this was placed under the upper part of the thigh of the injured side, after the application of the bandage.

The patient was placed on his back, the limb resting on the heel; and to prevent the possibility of any motion of the foot, and of the body, a wide board was fixed to the bed posts, at the foot of the bed, with two pieces of wood padded and fastened to it, between these the foot was received, and the least lateral motion prevented. A cushion was placed between the foot board, and the sole of the sound foot, so that by gentle pressure, the patient could prevent his body from slipping down in the bed.

This mode of treatment was steadily pursued for a month, without much inconvenience or suffering to the patient; the bandage being from time to time tightened. Until the expiration of three weeks, the patient said he could occasionally still feel the crepitus, but after that period, this sensation entirely dis-

appeared ; he complained of some pain in the direction of the trochanter, and the limb became somewhat edematous.

In a little more than a month, I again visited him ; and was then of opinion that union had begun, and directed a continuance of the same treatment, which was therefore persevered with for a further period of about ten weeks.

It was not until fourteen or fifteen weeks from the commencement of this treatment, that the bandage was removed for more than a few minutes, or that any material alteration was made in the plan. It was then taken off for about two hours ; when the trochanter was found to retain its position, and from examination of the parts, a considerable thickening could be discovered about the trochanter.

I then desired the bandage to be replaced, but to be removed every day for an hour, and directed friction to the limb from the foot upwards. Mr. B. from this time, rose every day, and was soon able, when supported by his crutches, to move his hip joint freely ; but the limb continued much swollen, and the motions of the knee joint were extremely limited. By steadily persevering with friction, and passive motion, Mr. B. has since obtained a free use of the extremity.

Case. Mr. Peggler, of Wanstead, aged forty-six, on the 13th of November, 1817, fell, while walking, on a glass bottle which he had in his pocket ;

and when he attempted to raise himself from the ground, he found he was not able to stand. In a quarter of an hour he felt great pain, and could not bear the slightest weight of his body on the injured limb. Mr. Constable, of Woodford, was sent for, and he gave me the following account of the case. The foot, at first, did not appear to turn out ; but when the patient was put into bed, and laid on his back, it became everted : the leg appeared somewhat shorter, but was with little difficulty pulled down to its natural length : the foot was benumbed, and continued so for twelve months. He was placed in bed, with a bolster under the hip to prevent displacement of the bone ; and his knees and ankles were tied together.

In December following, about Christmas, I met Mr. Constable, whilst visiting a patient with a severe injury of the head, and he then requested me to see Mr. Peggler, whom I found incapable of turning in his bed without assistance, and the attempt gave him great pain ; his injured leg was a little shorter than the other, and the trochanter was drawn forward towards the spine of the ilium, and could be felt considerably separated from that portion of the trochanter connected with the neck of the bone ; the foot was turned outwards ; he could not sit, and the least attempt to raise himself produced excruciating suffering. I brought him to the foot of the bed in an horizontal position, to make as accurate an examina-

tion as I could of the nature of the accident, and had no hesitation in pronouncing it a fracture through the trochanter. In less than a month he began to use his crutches, and continued their use for three months; he then laid aside one crutch, and employed a stick and crutch, and in a short time needed the support of a stick only; but it was twelve months before he recovered the entire use of his limb. The leg is still nearly an inch shorter than the other; the portion of the trochanter connected with the thigh bone has united with the fore part of the trochanter joined to the neck of bone, and is, consequently, much nearer the spine of the ilium than usual; the foot is also slightly everted, but he walks extremely well. A week ago he walked ten miles from home, and returned the same day; and this day, July 28th, 1819, he has walked from Wanstead to my house, and intends to walk back, a distance of near twenty miles.

This history of Mr. Peggler's accident is so similar to the cases of fracture through the trochanter major which I have had an opportunity of seeing, that a detail of the latter would only become an useless repetition; the only variations that I have witnessed having been in the distinctness of the crepitus accompanying them, which is less in proportion as the fracture approaches the capsular ligament. I have lately fractured through the trochanter major, five

different thigh-bones in the living animal; they united, but with great distension, shortening, and exuberant callus.

Diagnosis of the three kinds of fracture. As diminution of the length of the limb, and its eversion of the knee and foot, are signs which are common to fractures of the thigh bone generally, it may be proper, before quitting the subject, to bring into one view the means of distinguishing the three species of fracture which I have described.

The fracture of the cervix within the capsule is known, with very rare exceptions, by the very advanced age of the patient,—by its greater frequency in female than in male subjects,—by the absence of swelling and ecchymosis,—by the elevation and advance of the trochanter,—by the greater mobility of the joint, allowing flexion and extension, although with some pain, and resistance from muscles,—by a crepitus perceptible only on drawing down the limb to the same length with the other, and then rotating it,—by the pain felt at the trochanter minor,—by little constitutional irritation attending the accident,—by the slight causes which produce it,—and by the little local swelling or change of appearance which ensues.

Fractures of the cervix into the cancelli of the trochanter are known by the effusion of blood amidst the muscles,—by the great swelling and

ecchymosis which appears soon after the accident,—by an unnaturally fixed state of the joint, so that flexion and extension cannot be performed,—by excessive pain being produced on the least motion of the hip joint, and upper part of the thigh bone,—by a crepitus being perceived under the least motion of the thigh bone, without drawing it down to the length of the other,—and by the inflammation, swelling, and constitutional irritation produced, which are frequently destructive.

The fracture of the trochanter major may be easily known by the separation of the bone at the part, so that the finger may be placed between the fractured portions,—by the distinct crepitus felt in putting the fingers on the trochanter when the knee is advanced,—by the upper portion of the trochanter not obeying the motions of the lower, and of the shaft of the bone,—and when at the lower part of the trochanter, by great overlapping, distension and exuberant callus.

I have thus stated what dissection and observation have taught me of the three fractures of the upper part of the thigh bone, and shewn it to be a general principle, that fractures within the capsule do not unite by bone. I ought to add, that, in the museum of Mr. Langstaff, there is a preparation of fracture within, and of one external to the ligament; the latter firmly united by bone, whilst the former has scarcely undergone any ossific change. I can have

no wish but that these fractures within the capsule should unite by bone, if that result be desirable. I only state what dissection has taught me; and, with respect to contrivances to produce their union, I cannot extol them until there be some evidence of their value.

Fracture of the epiphysis. A peculiar form of fracture of the trochanter major, in which this process was separated at the part at which it is naturally united by cartilage as an epiphysis, occurred under the care of Mr. Key.

Case. The patient, a girl about sixteen years of age, fell in crossing the street, and struck her hip against the curb-stone. She rose directly, and walked home without much suffering or difficulty, but experiencing afterwards considerable pain, she was taken to Guy's Hospital on the sixth day after the accident. On account of her constitutional symptoms being much more severe than those usually attending injury to the hip, she was placed under the care of Dr. Bright, at whose request Mr. Key examined the limb, which he found considerably everted, and in appearance about half an inch longer than the sound extremity; it could be moved in all directions, but abduction caused great pain; no crepitus or displacement could be discovered, and her having walked both before and after admission into the hospital, gave rise to a supposition that fracture did not exist. Her constitutional suffering rapidly increased, accompanied with general unensi-

ness about the abdomen, and she died on the ninth day from the receipt of the injury.

After death, Mr. Key first examined the seat of injury externally, with attention, but could not discover any deviation from the natural state.

Dissection. On exposing the capsule of the joint afterwards, a cavity was discovered by the side of the pectineus muscle, passing backwards and downwards towards the trochanter minor, and containing some pus: it extended behind the bone to the large trochanter. On cutting through the ligaments, and dislocating the head of the bone, a fracture was first perceived at the root of the trochanter major. This fracture had separated the trochanter from the neck and body of the bone, without the tendons attached to the outer side of the process having been injured, so that a separation of the fractured portions could not take place, on which account the nature of the accident had not been detected during the life of the patient.

SECTION IV.

FRACTURE JUST BELOW THE TROCHANTERS.

Difficult to manage. When the thigh bone is broken just below the trochanter major and minor, much difficulty exists in effecting a good union, and if the treatment be ill-managed, great deformity is the conse-

quence. The fractured extremity of the superior portion of the bone is drawn upwards and forwards by the action of the psoas, iliacus internus, and pectenius muscles, and any attempts by pressure to obviate this position of the bone, only increases the suffering of the patient, without effecting the desired purpose.

Treatment. In the treatment of such a case, two principal circumstances require attention: first, to elevate the knee, by placing the limb over a double inclined plane, and secondly, to raise the body so as to place the patient in nearly a sitting position; the degree of elevation of the limb or of the body must depend on the approximation of the fractured ends of the bone, and the surgeon must carefully ascertain that the proper relative position of each portion of the femur is restored, before he proceeds to apply the splints and bandages to retain them in this state. A strong leather belt lined with some soft material, and made to buckle round the limb, answers better in these cases, than the common splints.

Specimen of. A preparation in the museum at St. Thomas's Hospital exhibits the mode of union in an ill-treated case of this kind, and illustrates the necessity of careful attention to the points I have mentioned, viz.: the relaxation of the psoas, iliacus internus, &c., by elevating the body, and the raising of the inferior portion of bone to a line with the superior.

b. Fractures of the middle third, or shaft, of the bone.

Fractures of the shaft of the femur may be *simple* or *compound*; they may also be complicated with a wound of the femoral artery, which, however, is a rare occurrence. Sir Astley Cooper met with such a case, in which it was necessary to perform amputation. Fractures of the thigh bone may also be *double*. In children, the shaft is frequently broken in the *transverse* direction; but in other subjects, the fissure is most commonly *oblique*. The fracture may be caused by direct violence, as by the passage of the wheel of a heavy carriage over the limb, the fall of a heavy body upon it, the kick of a horse, and various other kinds of injury; but, on other occasions, the femur is broken by some description of force, which first bends it, and, when it has yielded as much as it can, it breaks, generally at some point of its middle third.

SECTION V.

SYMPTOMS OF FRACTURE OF THE SHAFT.

Shortening of the limb. Supposing the fracture to be oblique, a shortening of the limb is usually noticed, the lower fragment being drawn behind the upper one, and a little inwards; the limb is flexible in the situation of the fracture; the lower fragment, with the knee, leg, and foot, is rotated outwards, all the stronger muscles acting upon that part of the broken bone,

tending to twist it in this direction. Although the lower fragment is commonly drawn upwards and inwards behind the upper one, it is possible for the lower fragment to be displaced in a different manner, and so as to lie in *front* of the upper one; but this occurrence is a deviation from what is ordinarily seen, and is explicable by the particular mode in which the accident has been produced, by the application of direct violence, and the operation of the force upon the posterior part of the limb, so as to propel the lower fragment forwards.

Crepitus Another symptom of a broken thigh is a crepitus, that can be distinctly felt on moving the limb. If the fracture be an oblique one, together with the shortening of the limb, there is a rotation of it outwards, and what is termed the angular deformity, the axis of one portion of the bone not corresponding to that of the rest of it.

Swelling or fulness of the limb. The retraction of the lower fragment constantly occasions an increased bulk, or fulness of the upper part of the thigh, because the attachments of several of the muscles are brought nearer together, and their bellies swelled into a preternatural shape. The truth of this observation is well illustrated in the state of the adductor muscle, which, by forming a considerable prominence at the upper and inner part of the thigh, communicates to it a very unnatural shape.'

That it is the muscles which produce the displace-

ment of the fractures, cannot be doubted, because, if the muscles of the broken limb were paralytic, there would not be any retraction of the lower fragment, or shortening of the thigh. In a person affected with paralysis, there might be no shortening of the limb at first, or while the muscles were incapable of action ; but if the paralytic affection happened to yield before the fracture had united, a retraction of the lower fragment would yet ensue. Indeed, such a case was under Désault in the Hôtel Dieu, and is recorded by Bichat. When the accident took place, all the muscles of the lower extremity were in a paralytic state ; and though the fracture was an oblique one, no retraction whatever of the inferior fragment followed. The moxa was applied, and, in a few days, the muscles began to regain their power of action ; and in proportion as this improvement was effected, the ends of the fracture acquired a tendency to displacement, not previously evinced, and a considerable retraction of the lower fragment ensued.

Appearances in transverse fracture. In transverse fractures of the shaft of the femur, no shortening of the limb may happen, yet the angular deformity and rotation outwards will be observed. The foregoing observations render it manifest, that it is chiefly the lower portion of the broken femur which is displaced ; but it would be incorrect to regard the displacement as exclusively affecting only the lower fragment. When the patient

is placed on too soft a bed, which yields to the weight of his trunk, the pelvis sinks, and pushes the upper fragment along with it, which thus has a disposition to be propelled over the lower one. Supposing also the fracture to be situated just below the trochanter minor, the psoas and iliac muscles, attached to that process, might act with great effect in displacing the upper fragment in the direction forwards and upwards.

Pott's plan of relaxing the muscles. It was principally with reference to fractures of the lower extremity, that Mr. Pott recommended the plan of attending to the relaxation of the muscles as the best means of facilitating the reduction, and promoting the maintenance of the fragments in their right place. One would suppose, from several passages in his treatise on this subject, that he really imagined it possible completely to relax all the muscles by a certain position of the limb, and this in such a manner as entirely to deprive them of all power of disturbing the ends of the broken bone. No position of the limb, however, will do so much as Mr. Pott was induced to believe. A certain position may relax those muscles, which have the greatest power of disturbing the fracture; yet the mass of muscular fibres remaining unrelaxed, will always be sufficient to derange the fracture; and consequently position alone, however important and useful it may be, will not accomplish strictly what Mr. Pott represents; it will not effectually deprive the muscles

of the power of disturbing the fracture. This truth enables us at once to understand how necessary it is to attend to other means for maintaining the reduction, and especially to avail ourselves of the best mechanical contrivances for this purpose. So correct is the principle which I am now adverting to, that if the particular position of the limb, selected for the purpose of relaxing the muscles, were to be incompatible with the employment of the most efficient apparatus, then, the treatment would be erroneous, because, advantageous as position certainly is, inasmuch as it is the means of relaxing the most powerful muscles connected with the broken limb, the aid of an efficient apparatus is still more important.

SECTION VI.

TREATMENT OF FRACTURES OF THE SHAFT.

Broken thighs are treated on three different plans, each of which is occasionally preferred. In the first, the limb is kept extended, and the patient lies on his back ; a position disapproved of by Pott, because it does not relax those muscles which have the greatest power in producing displacement, namely, those which are capable of drawing the lower fragment upwards, inwards, and behind the upper one ; or, in other terms, the muscles arising from the

pelvis, and inserted either into the femur, the patella, the tibia, or the fibula; and which, making the pelvis their fixed point, and the portion of the limb below the fracture their moveable one, displace the lower fragment in the foregoing direction.

Désault's plan. In the extended position, various kinds of long splints are employed. Désault employed three splints; one on the outside of the limb, a second on the inside, and a third on the upper part, or front of the thigh. He was very particular in placing the patient on a firm unyielding bed; for if the pelvis sinks into a hollow of the bedding, this change will inevitably derange the position of the fragments. He began with applying the eighteen, or many-tailed bandage, then a long splint, well padded, on the outer part of the limb; he next put a handkerchief or band on the perineum, or rather on the tuberosity of the ischium, the ends of which handkerchief or band were carried through a fissure in the upper part of the long external splint, and the effect of this was to prevent the splint from slipping upwards. Then the foot was also made steady by passing a handkerchief or bandage through a fissure in the lower part of the splint, which was brought over the foot across the instep, and then fastened to the splint again. Thus the limb was fixed and secured both at the hip and the foot. Other splints, however, were made use of; one at the inner side of the limb, extending from the groin to

the foot, and a shorter one, reaching along the front of the thigh from the groin to the knee-pan. The objection to Désault's apparatus is, that the bandage, which is intended to go over the tuberosity of the ischium, can never be kept in the proper position; it always slips down on the thigh, and there produces an inconvenient degree of pressure, pain, and sometimes ulceration and sloughing.

Boyer's apparatus. Hence Baron Boyer invented another apparatus, which was also intended to be used in the straight position of the limb. His long external splint is furnished with a screw at the lower end, by means of which it can be lengthened or shortened at pleasure. The principle of his apparatus is to keep up permanent extension; but, for the screw to have its full effect, it is necessary, that the upper end of the splint should be securely fastened to the pelvis. For this latter purpose, Boyer put a thigh-strap over the tuberosity of the ischium, much in the same manner as Désault did the hand-kerchief, or band; but the portion of the thigh-strap below the crista of the ilium, on the outside of the pelvis, had a kind of fob or pocket in it, calculated to receive the upper end of the splint, and thus prevent it from slipping upwards, or moving at all laterally. The limb having been first put up with the many-tailed bandage, the long external splint, lined with soft materials, is applied; the foot is next fixed much in the same way as in

Désault's plan, and the inner and upper splints are put on, the extension being kept up by lengthening the outer splint, which is done by turning the screw at the lower part of the splint. This is a better plan than Désault's, and it has been sometimes tried in London; but it is liable to one of the objections urged against Désault's method, namely, that the strap, which goes across the upper part of the thigh, causes a great deal of pain and other inconveniences, while that on the foot sometimes produces ulceration and sloughing.

Pott's mode of treatment. The second plan of treating fractures of the shaft of the femur is that recommended by Pott, in which the limb and the pelvis are laid on their external side, with the thigh half bent upon the pelvis, and the leg moderately bent upon the thigh. In this method, two splints are sometimes applied, but generally four. The fracture is reduced by an assistant taking hold of the limb above the broken part of the bone, and performing counter-extension, while the surgeon makes extension from a part of the limb below the situation of the injury. The patient is laid on his side, with the pelvis inclining as much as possible in the same direction. The limb is placed on its outer side, with the thigh half bent upon the pelvis, and the leg bent in a similar degree upon the thigh itself. Before reducing the fracture, the long splint, with the pad and eighteen-tailed bandage upon it, should be put under the thigh; the reduc-

tion of the fracture is then to be accomplished, and the tails of the bandage next methodically laid down, one over the other, beginning with those just above the knee. The eighteen-tailed bandage, when neatly applied, looks exceedingly well, and is convenient; for it can be opened without the slightest disturbance of the fracture, or motion of the limb. In private practice, it is usual to apply, under the bandage, a piece of brown soap plaster to the integuments in the immediate vicinity of the fracture. By proceeding in the manner here explained, the other splints may be applied with the greatest facility. When Pott's position is adopted, one important thing is to afford due support to the foot; for which purpose a soft cushion or pillow is generally employed; and the knee must also be supported by similar means. But this treatment of broken thighs in the bent posture, with the patient on his side, is, I think, not exactly consistent with the most scientific principles. In the first place, one general principle, acknowledged by all the best practical surgeons, is that of keeping all joints in any way connected with a fractured bone perfectly motionless; but here no measures are taken for the fulfilment of this very important object. On the contrary, the patient can move every joint without restraint. The splints do not confine either the hip, the knee, or the ankle: hence I should say, that this is an inferior method of treatment, and I am not surprised, that it should be

one which occasions deformity more frequently than any other *. But supposing this position were in some respects the best that could be selected, yet, as it could not be maintained for any length of time, it would prove inefficient. In fact, take what pains we may, the patient will never remain long in the posture we have placed him in, but will always turn on his back, and thus the fracture will become deranged again.

Treatment by
the double inclined
plane. Within the last twenty-five years, a third plan has been proposed and adopted, which consists in placing the patient on his back, with the thigh bent on the pelvis, and the leg bent on the thigh, while the limb is supported in this position on a *double inclined plane*. The most simple instrument of this kind merely consists of two boards of the requisite length, nailed together at an angle, and provided with a foot-piece, and a few pegs along the margins, to keep the pads from slipping off the apparatus. Double inclined planes, however, are now brought to great perfection ; and fracture beds, as they are called, are generally so constructed as to admit of serving the same purpose. In the North London Hospital, M'Intyre's apparatus is preferred, as being more simple, and not requiring, in addition to the front splint, any lateral ones, unless the thigh be very bulky ; nor does it require the eighteen-

* See page 292.

tailed bandage, a common roller being applied so as to include both the limb and the apparatus on which it lies, and, consequently, admitting of removal without any disturbance of the part. All well made double inclined planes can be fixed at any angle by means of a screw.

^{Amesbury's} apparatus. In Amesbury's apparatus, which answers as a double inclined plane, the thigh part may be lengthened or shortened at the surgeon's option, the brass part sliding very conveniently in either direction, which is a great advantage: the foot-piece also admits of being shifted, and its position and length can be adapted to the particularities of every case. If this, or any other double inclined plane, be used, we have no occasion for an under splint, because the surface of the machine itself answers the purpose of one. The ankle is kept steady by means of the leather case or slipper for the foot. Three splints then are to be applied, one on each side of the thigh, and one along the front part of it. The limb will thus be kept perfectly steady, and all the joints motionless. By means of the thigh-strap and pelvis-strap belonging to the apparatus, the pelvis and lower extremity become, as it were, one piece, only moveable together. The strap is passed round the pelvis, and through the fissure in the upper part of the external splint, near the great trochanter. Amesbury's is one of the best inclined planes we have: it is excellently finished, and the splints of a

good shape, light, yet strong. M'Intyre's is more simple, however, and is found, in the North London Hospital, to answer every purpose. A block of wood belongs to it, the use of which is to fix the heel, and keep it at a convenient height. The treatment of broken thighs on double inclined planes is much approved of at the present day, and is found to be less irksome to the patient than other plans. It cannot be doubted, I think, that it is a more scientific method than Pott's, which leaves all the joints unsupported and moveable, and has no contrivance, except the cushion, for keeping the foot motionless and in the right position. A double inclined plane is always to be well covered with soft materials, especially the projecting part of it under the ham.

c. Fractures of the lower third of the Femur.

SECTION VII.

OBLIQUE FRACTURES OF THE CONDYLES OF THE OS
FEMORIS INTO THE KNEE JOINT.

Signs of. Either the external or internal condyle of the femur may be separated by fracture from the rest of the bone, producing much deformity of the knee joint, and giving rise to great swelling; which circumstances, together with the feeling of crepitus

when the joint is moved, indicate the nature of the injury. In either case, the same mode of treatment is required.

Treatment. The injured limb is to be placed upon a pillow in the extended position ; leeches and evaporating lotion are to be employed, until the inflammation is subdued ; after which, a piece of stiff paste-board, about a foot and a half in length, and of sufficient width to envelope the posterior and lateral parts of the knee joint as far as the sides of the patella, is to be applied wet, and secured by a roller ; this, when dry, adapts itself to the form of the joint, and best confines the fractured portion of bone. In five weeks, passive motion should be employed, to facilitate the recovery of the motions of the articulation.

Compound fracture. Compound fracture of the condyles of the os femoris is a rare accident ; and in the old, or irritable, is most likely to be attended with fatal consequences, unless the limb be removed. In young persons, or in those who are not of an irritable constitution, a cure may be effected, unless the opening be very extensive, or attended with much surrounding mischief.

Case. A boy was admitted into St. Thomas's Hospital, in September, 1816, under the care of Mr. Travers, having a transverse fracture of the femur just above the condyles, and an oblique fracture of the external condyle, with which a small wound communicated ; the limb was placed in a

fracture box in the semi-flexed position. The patient suffered but little from constitutional disturbance, although the integuments over the injured condyle ulcerated, so as to expose the bone, which was removed in November, in consequence of having lost its vitality. After this, the limb was placed in the straight position, as ankylosis was deemed unavoidable, but the lad recovered with a perfectly useful joint.

SECTION VIII.

OBLIQUE FRACTURE OF THE FEMUR, JUST ABOVE THE CONDYLES.

Consequence. The consequences of this injury are often very lamentable, producing great deformity of the limb, and destroying, in a great measure, the motions of the knee joint.

Causes. The injury is generally produced by a fall from a height upon the feet, or upon the knee when the joint is very much flexed.

Specimen of, examined. Mr. Paty, surgeon, of Bouverie Street, Fleet Street, has a preparation, showing the great deformity consequent on this injury ; it was taken from a subject brought into the dissecting room at St. Thomas's Hospital. Before dissecting the parts, it appeared that the femur had been fractured just

above the condyles, and that the inferior part of the superior portion of the bone projected as far as the upper part of the patella, being only covered by the skin ; the size of the bone was much increased. On examining the seat of injury, the end of the superior portion of bone was found to have pierced the rectus muscle, through which it continued to project. The patella could not be drawn upwards, as it was stopped by the extremity of the bone. The condyles of the femur and the inferior portion of bone had, by the action of the muscles, been drawn upwards and backwards behind the inferior part of the superior portion, to which it had united very firmly.

Independent of the deformity in this case, the motions of the knee-joint must have been very limited, as the rectus muscle was hooked upon the projecting extremity of bone anteriorly, which also prevented the ascent of the patella.

Best mode of treatment. The best mode of treatment to obviate these great evils is, first to flex the joint as much as possible, to liberate the rectus muscle at the same time supporting the condyles over some fixed body, to prevent their receding, and afterwards firmly to extend the limb and so prevent retraction.

The following cases will explain the difficulty of effecting these objects ; the first was under the care of Mr. Welbank, junior.

Case. A gentleman of middle age, a tall and powerful man, was thrown from his gig in June,

1821. The medical attendant, who was called to see him, found him lying on a bed, to which he had been carried, with his right leg bent across the left at an angle. At first view, it appeared that there was a lateral dislocation of the knee, a deep hollow was seen on the outer side, in the situation of the condyles, and above it a sharp projection. On examining more attentively the seat of injury, an oblique fracture of the femur was found just above the condyles; considerable effusion existed in front of the joint around the patella, which could not be distinctly felt. After the fracture had been reduced, which was readily effected by slight extension, a ridge could be felt just above the patella, which, upon a superficial examination, might have been mistaken for a transverse fracture of that bone. If the limb was flexed, a great deformity resulted from the projection of the upper portion of the fractured bone, which disappeared again on extending the limb. The sensation of crepitus was very indistinct.

The extremity was placed in an extended position, and secured by the application of short splints, for the space of a week, during which time means were employed to reduce the inflammation of the capsule, consequent on the injury. After this, a long splint was applied on the outer side of the limb, from the trochanter major to the foot, and a shorter one on the inner side, from the middle of the thigh to the middle of the leg; these were firmly confined by bandages,

and the limb was supported upon an inclined plane. In consequence of frequent variation in the projection of the upper portion of bone, weights were subsequently appended to the foot, to keep up a constant extension, which appeared to be advantageous.

In September following, the union was thought to be sufficiently firm, and the patient was carefully removed to Eastbury, Herts, in a litter-carriage, with his limb still in the same position. It being found, however, that alteration of posture, or any attempt to flex the limb, produced a greater projection at the seat of fracture, the former plan of treatment was continued for another fortnight. Upon a further examination after this period, a degree of lateral motion could yet be felt, and the projection of the fractured bone was still increased by bending the knee, indicating that the union was not yet firm, in consequence of which the limb was again placed at rest, and a circular belt was tightly buckled around it at the seat of injury, to press the fractured parts together, and to maintain them in firm apposition. In the middle of October, the patient was first allowed to get up, the union being then complete, and he has since gradually recovered the use of the limb, so as to be able to walk without assistance, but he has little power of bending his knee, the upper part of the patella being caught against the projecting portion of the femur, which is still evident. The limb is

somewhat shortened, and the thigh inclined outwards.

Case. Mr. Kidd, who was tall, muscular, and in weight fifteen stone, fell from a height of twenty-one feet, and by the severity of the concussion, fractured his thigh bone obliquely, just above the condyles, and the lower part of the superior portion of the bone, penetrating through the rectus muscle and integuments, appeared just above the patella. He was immediately carried home, and I was requested to see him by Mr. Phillips, surgeon to the king's household, who had been called to him. The projecting extremity of the superior portion of bone was sawn off, and the fracture reduced; the edges of the wound were then carefully brought together, and the limb was placed over a double inclined plane. The wound healed without difficulty, which was extremely favourable. The accident occurred on the ninth of November, 1819, and on the thirtieth, splints were applied to press the bones together. On the twenty-third of December the limb was placed in an extended position, which was continued until the beginning of February. The patient was then allowed to sit up; but on a careful examination of the limb, the union of the fracture was ascertained not to be complete, and a leather bandage was therefore placed around the injured part, and tightly buckled, to secure the bones in a proper position. On the 3rd of May, the union was found to be complete, and after a few days

the bandage was removed, the limb being supported by a pillow. He was still unable to leave his bed in consequence of the great swelling of the leg, and some degree of superficial ulceration from the application of the leather bandage. On the nineteenth of July he was removed from London to Kensington upon a litter. A considerable period elapsed before the swelling of the limb subsided, or before he was able to be moved to a sofa. At the end of January, he was on crutches for the first time, and in about a month after, took his first walk out of doors.

After union was complete, the inferior part of the upper portion of the bone, which had been broken, continued to project, its size was very much increased, and the patella was fixed to its extremity, to which also the skin adhered.

Apparatus for extension.—I have had an apparatus constructed, which I think better calculated to preserve the limb in a constant state of extension, than that employed in either of the above cases. It consists of a straight splint, long enough to reach from the upper and inner part of the thigh, as far as several inches below the sole of the foot; the upper extremity is hollowed and padded, so as to fit in between the scrotum and thigh, against the side of the pubes; and the lower part resembles that described and employed by Boyer; having a boot which fixes by the sole, to a bolt projecting at right angles from the splint; the bolt is

connected with a screw, let into the lower part of the splint, and on turning this screw, the bolt is carried upwards or downwards, according as the screw is moved to right or left.

Mode of application. After having liberated the rectus muscles from the broken extremity of bone, by bending the knee as before directed, the limb is to be extended, and the apparatus applied on the inner side of the limb, in the following manner.—The upper padded end being placed between the scrotum and thigh, against the side of the pubes, the foot is to be received into the boot, and confined there by closing the front with a lace in the usual manner, or with straps and buckles ; then by turning the screw, the bolt connected with the sole of the foot, and consequently the boot and foot are made to descend, thus, the upper part of the splint being fixed against the pelvis, the whole force of the instrument is exerted upon the limb, and a powerful mode of extension is afforded.

CHAPTER IV.

FRACTURES OF THE PATELLA.

Forms of. THE most common fracture of this bone, is transversely; sometimes, however, it is broken longitudinally; sometimes it is simple, very rarely compound.

SECTION I.

TRANSVERSE FRACTURE OF THE PATELLA.

When fractured transversely, the superior portion of bone is separated from the inferior by the action of the rectus vasti and crureus muscles, which are inserted into it and tend to draw it upwards. The lower portion of the bone remains in its natural situation, connected to the ligamentum patellæ.

Extent of separation. The degree of separation will be found to vary from half an inch to five inches, and it depends upon the extent of laceration of the capsular ligament, and tendinous aponeurosis covering it.

Signs of. The nature of the injury is readily recognised, on examination;—by the fingers, when pressed between the two portions of bone, sinking

nearly to the condyles of the femur ;—by the situation of the upper portion of bone ;—and by its free lateral motion upon the anterior and lower part of the thigh bone. The patient cannot extend the limb, nor can he support the weight of the body upon it when standing ; as the knee immediately bends forwards from the loss of action in the extensor muscles. The injury, if simple, is attended with but little pain, and is not productive of much constitutional suffering.

^{Consequent} ^{swelling} A few hours after the receipt of the accident, the part becomes tumid from extravasation of blood, and the surface presents a discoloured appearance from ecchymosis, this, however, subsides in a few days, but the joint enlarges from an increased secretion of synovia, and from effusion in consequence of inflammation. The portions of bone being separated, no crepitus can be felt, like that which happens in other fractures.

The separation of the bones is much increased by bending the knee, as this act removes the lower from the upper half of the bone, pulling down the tibia, ligamentum patellæ, and the lower portion of the bone from the upper.

^{Causes.} Two causes are found to produce this injury :—First, falls upon the knee, or blows upon the patella when the patient is erect. Second, the action of the extensor muscles upon the bone, in any sudden effort to prevent a fall.

Cases. I was called to attend a gentleman, who had fractured his patella by an effort which he made to save himself from falling, after having leaped over a broad ditch. I also saw a lady, who met with the same accident, in endeavouring to save herself from a fall, when descending some stairs, having placed her heel too near to the edge of one of the steps.

Explanation. It may appear extraordinary, that the action of the muscles alone is sufficient to produce fracture, but a little attention to the structure and mode of action, easily explains the fact. When the knee is bent, the patella is drawn down on the end of the condyles of the femur, and the upper edge of the bone projects forwards, so the muscles do not act in a line with the patella, but at right angles with it, and more particularly upon its upper portion.

Mode of union. The union in these cases is generally ligamentous, whether the portions of the fractured bone be nearly approximated, or widely separated. Soon after the accident, blood is poured out, and fills the space between the lacerated ligament and broken pieces of bone, but this soon becomes absorbed, and its place is occupied by adhesive matter thrown out in consequence of inflammation; this soon becomes organised by vessels from the edges of the injured ligament, and a structure, similar in its character to ligament, is thus produced, by which the parts divided by the injury are again united. Sometimes this new

structure does not completely fill up the space formed by the separation of the portions of bone and ligament, but has apertures in it; this most frequently occurs when the separation is very great, or when the limb has been moved too soon after the accident.

Dissection. On examining the seat of injury, some time after the accident, I find that the patella itself undergoes but little change, the inferior portion has its broken surface very little altered, being only somewhat smoothed; the upper portion has its fractured surface covered with some ossific deposit, so that there is more ossific action in the superior than in the inferior portion of the bone. The articular surface maintains its natural appearance.

Experiments. By experiments on the rabbit, I have been able to trace the mode in which this injury is repaired. In each experiment I divided the patella, by placing a knife on the bone, and striking it gently with a mallet, having first cut through the integuments, which I drew as much as possible to one side, so that when allowed to resume their natural situation after the division of the patella, the wound was not opposite the fracture.

Appearances,
present at va-
rious dates after
the experiments. On examining the parts forty-eight hours after the division, I found the portions of bone separated to the extent of three quarters of an inch, and the intervening space filled with coagulated blood. In a second experiment, which I

examined eight days after, most of the blood was absorbed, and adhesive matter deposited in its place. In a third, which I examined on the fifteenth day, the adhesive matter had become smooth and somewhat ligamentous. In a fourth, examined on the twenty-second day, the new ligament was perfect. A fifth examined at the expiration of five weeks, and injected, showed the organisation of the new ligament, which was chiefly supplied by vessels from the original ligament, and by a very few vessels from the bone.

Bony union seldom occurs. In repeating these experiments upon the rabbit and dog, I could not succeed in producing a bony union, although I could keep the fractured pieces in perfect contact. I believe, however, that ossific union may, now and then, be produced ; in a case which I saw with M. Chopart at Paris, there was every appearance of such a junction, and Mr. Fielding of Hull has published another case.

Union by ligament to be as short as possible. As in a large majority of these cases I believe the union to be ligamentous, it is extremely desirable to make the ligament as short as possible. The degree of recovery of the power of the limb is proportionate to the approximation of the fractured portions of the patella, or the shortness of the new ligament ; for, as the superior portion of the bone is separated from the inferior, by the action of the rectus muscle, so the muscle becomes shortened, and its power consequently diminished. When,

therefore, the intervening ligament is very long, the person cannot walk fast without a halt, and is in constant danger of falling.

Treatment. In the treatment of the transverse fracture of the patella, the patient should first be placed in bed upon a mattress, with the injured limb extended, behind which a hollow splint, well padded, should be applied. The heel should be elevated a little, and the body raised, in order to relax, as much as possible, the rectus muscle, and thereby prevent it from drawing up the superior portion of the fractured bone. The limb should be fixed to the splint to prevent its slipping, and the surface of the joint should be kept constantly moist, with an evaporating lotion. If there be much tension or pain succeeding the injury, the application of leeches will be necessary, with a continuance of the evaporating lotion. In a few days the swelling and pain will subside under this plan of treatment, after which the bandages may be applied to approximate the portions of bone. The surgeon should be very careful not to apply the bandages before the tension has been reduced ; I have known severe suffering and inflammation produced by their too early application, so much so in some cases as to threaten a sloughing of the integuments.

Common bandage. The most common mode of using the bandages is as follows : a roller is first applied from the toes to the knee, to prevent swelling of the leg ;

two pieces of broad tape are then placed on each side of the patella, in the direction of the limb, and two rollers are next bound round the extremity, one above, and the other below the knee joint, confining the pieces of tape, and having the two portions of bone between them; the ends of tape on each side are afterwards turned over the rollers, and tied so as to bring the rollers nearer to each other, and thus press the portions of the fractured bone as near as possible together. The splint is again applied and fixed to the limb, to prevent any flexion of the joint; the heel is still raised, and the body supported nearly in the sitting posture.

Another mode. I usually adopt a rather different mode, which I think preferable. It consists in buckling a leather strap around the lower part of the thigh, immediately above the superior portion of the patella, and having another strap attached to the former on each side, long enough to pass under the sole of the foot, by which the circular strap can be drawn down, and with it that part of the broken bone connected to the tendon of the rectus muscle. The splint and the position are attended to as above mentioned. *

Period of confinement. It is necessary in the adult to continue this treatment for five weeks, and in elderly persons for six weeks. Passive motion may then be employed, but very cautiously, until it be ascertained that the union is sufficiently firm to bear it without

risk ; it may then be continued from day to day until the joint can be completely flexed.

Passive motion essential. Passive motion is very essential to promote the return of power in the muscles and joint, as without it many months will elapse, and the patient still be incapable of flexing the limb. When passive motion is to be employed, the patient should be seated upon a high stool or table, in such a manner that the edge of the seat reaches as far as the ham, so that the leg can be depressed without the thigh ; this is to be done with considerable care at first, until a slight degree of motion has been acquired, when the patient may, by swinging the leg, and directing his mind to the contraction of the rectus and exterior muscles, gradually restore the functions of the joint. If the union has taken place with a shortened state of the rectus muscle, and the portions of bone are joined by a long intervening ligament, the muscle does not recover its voluntary power until it has been again elongated, which is done by bending the knee.

Case. A young woman who had suffered from transverse fracture of both patellæ, was brought to my house, in consequence of not having recovered any power of flexing the limbs. Passive motion was employed, and she was directed to extend the limbs, when they had been flexed by the surgeon ; in this manner, after persevering for some time, she gradually recovered the use of the joints. The pain created

by the passive motion, and the very gradual benefit derived from it, make patients averse to its continuance, but it is perfectly essential to recovery. Mr. John Hunter always dwelt most ably upon this subject in his lectures.

SECTION II.

PERPENDICULAR FRACTURE OF THE PATELLA.

This injury, as the former, is attended with considerable effusion and swelling of the soft parts.

Unites mostly by ligament. Having seen several cases in which the union had only been effected by ligament, and not being aware of any circumstance that should prevent ossific junction, I made several experiments upon dogs and rabbits, the result of which was as follows :—

Experiments. Having produced fractures in a manner somewhat similar to that already described, for occasioning the transverse division of the bone, sufficient time was allowed for the process of cure to be completed, when the bones were examined, and found to be joined only by ligament, and the two portions considerably separated from each other, from the pressure of the condyles of the femur upon the inner surface of the patella when the knee was bent.

I therefore made another experiment, and divided the patella in a dog, but in such a manner, that the tendon above, and the ligament below, remained uninjured, so that there could be no separation of the fractured portions ; in this case, I found that a perfect ossific union took place.

Conditions for union by bone. It appears, then, that in either the longitudinal or transverse fractures, when the portions of bone are separated, a ligamentous union takes place ; but if these portions remain in contact, they may become united by bone.

Case. Mr. Marryat had his patella broken into three portions, by a fall from his gig ; the bone was divided by a transverse fracture, and the lower piece again divided by a perpendicular fracture ; the transverse fracture united by ligament only, whilst the perpendicular fracture joined by bone.

Experiment. I fractured the patella of a dog, separating it into four portions by a crucial division ; no union took place between the two superior pieces, neither to each other, nor to the inferior, but the inferior portions became united to each other by bone.

Treatment. The treatment of this accident consists, in placing the limb in an extended position with a padded splint posteriorly, to prevent any motion of the knee joint ; in applying an evaporating lotion until the swelling and pain have subsided, after which, a knee cap padded on each side of the patella should

be buckled around the joint, the straps passing above and below the patella.

SECTION III.

COMPOUND FRACTURE OF THE PATELLA.

Extent of mischief. When this accident is attended with extensive laceration, and much contusion of the surrounding soft parts, it will be right immediately to amputate the limb; but should the wound be small, so that its edges can be readily approximated, and not accompanied with such mischief as is likely to occasion sloughing, an attempt should be made to preserve the extremity.

Treatment. The principal object in the treatment, is to produce adhesion of the edges of the wound; to effect which, all our efforts should be directed. The application of sutures is necessary, not only to assist in the immediate approximation of the edges of the wound, but to prevent their after separation, which is otherwise liable to take place from the escape of synovia, and the lax state of the integument; besides the sutures, strips of adhesive plaster should be placed, and the part kept cool by the evaporating lotion. Poultices or fomentations must not be used, as they prevent the adhesive process.

454 COMPOUND FRACTURE OF THE PATELLA.

Case. A man in St. Thomas's Hospital, under the care of Mr. Birch, had fomentations and poultices employed, after an injury of this nature, in which but a small wound communicated with the joint,—he died in consequence of excessive constitutional irritation, produced by suppurative inflammation, which took place in the joint.

The following case, which was under the care of Mr. Dixon, of Newington Butts, will fully explain the mode of treatment I would recommend.

Case. Mr. Redhead, aged 39, of a spare habit, was thrown from his gig, June 18, 1819, when his knee striking against the wheel of a cart, produced a compound fracture of his patella. At Mr. Dixon's request, I visited the patient in the afternoon of the day on which the accident had occurred, and on examining the joint, I found a wound on the fore part, which readily admitted my finger into the joint; the patella was broken into several pieces, one of which, being detached, I removed. From the habit of the patient, and his not having an irritable constitution, we determined on attempting to preserve the limb. I accordingly brought the edges of the wound together by the application of a suture, taking care not to include the ligament; I then further secured the closure of the wound by strips of adhesive plaster, and over the whole, I placed a roller very lightly, which was to be kept constantly

moistened with spirit of wine and water. The leg was placed in an extended position, and he was ordered to live on fruit. The suture was not removed until the 30th of June, as he did not at all complain. At the expiration of a month, Mr. R. was allowed to leave his bed ; and in five weeks from the accident, passive motion was commenced. He gradually recovered the perfect use of his limb.

Case. In the year 1816, a case happened in Guy's Hospital, in which the knee joint was opened by ulceration, some time after the occurrence of a transverse fracture of the patella, which had united by a ligament about three inches in extent ; the patient, a woman, was admitted into the hospital, in consequence of having numerous ulcers on various parts of her body, one of which was seated in the integument, immediately over the new formed ligament uniting the broken patella ; this ulcer became sloughy, and extended through this ligament into the joint, in which excessive inflammation and suppuration occurred, which destroyed the patient.

CHAPTER V.

FRACTURES OF THE BONES OF THE LEG.

Their liability to fracture. It might be supposed, on looking at the bones of the leg, and observing one of them so strong while the other is comparatively slender, that the fibula would, most frequently, be the seat of fracture; this, however, is not the case. The tibia, strong as it is, is more frequently the seat of fracture than the fibula, on account of its superficial and exposed situation in front of the leg; in fact, its anterior surface is merely covered by the integuments. Another reason is, that the tibia receives all the weight of the body when a person leaps, or alights with his foot forcibly on the ground. The fibula, on the contrary, is covered to the extent of its two superior thirds by thick muscles, while the lower third of it is, to a very great extent, protected by the tibia itself. Indeed, the peronæi muscles alone are sufficient to guard it from the effects of ordinary degrees of violence directed against the outside of the leg. The fibula therefore is, on the whole, less frequently broken than the tibia; still the accident is common enough; so common, indeed, that Dupuytren calculates, that fractures of the lower third of the fibula amount in number to one-third of all fractures of the legs.

SECTION I.

FRACTURES OF THE SHAFT OF THE BONES OF
THE LEG.

Causes. In cases, where the tibia alone is fractured, the injury is generally caused by direct violence, more especially if the fracture happen at any point of the two upper thirds of the bone; it is then usually produced by a blow, a kick, or the passage of the wheel of a heavy carriage over the limb. The lower third of the tibia may be fractured either by direct or indirect violence, or as the result of what the French surgeons call a *contre-coup*. Fractures of the upper two thirds of the fibula are generally caused by direct violence, while those of its lower third are most frequently occasioned by a forcible twist of the foot, either to the outer or inner side. The twist most commonly happens in the direction outwards, and, when this is the case, the fibula usually breaks from two to four inches above the external malleolus. When the fibula is broken as well as the tibia, the later bone generally gives way first, and then the weight of the body being transmitted to the fibula, this bone also breaks. Such is the explanation offered by Dupuytren, as applicable to the majority of cases; but sometimes both bones are fractured at once by direct violence, as happens when the wheel of a heavy carriage passes over the limb.

458 FRACTURES OF THE BONES OF THE LEG.

Signs of fractured tibia.

Fractures of the upper third of the tibia are frequently transverse; but when situated in the two lower thirds of the bone they are generally oblique. When the tibia alone is broken, and the fracture is situated in the upper third of it, some attention is necessary to discover the nature of the accident, because there is no change in the shape of the limb; for the fibula, being perfect, acts as a splint, so that there can be no shortening of the member, while the extensive surface of a fracture, in this situation, tends equally to prevent both retraction and displacement. The slightest inequality of the tibia, however, may always be detected by passing the finger along its anterior edge or spine, when, if there be a fracture, some projection or irregularity will be perceived at that part where the fracture is situated; we shall also perceive, on moving the ankle and knee rather freely, that exactly at the point where solution of continuity exists, the bone, instead of being firm and unyielding, has a degree of motion in it, and yields when pressed upon.

Signs of fractured fibula.

If fracture of the fibula be produced in consequence of the foot being twisted outwards, the inner edge of the sole will be in contact with the ground, and the upper end of the lower fragment will incline inwards towards the tibia. If the fibula be fractured by the foot being twisted inwards, the outer edge of the sole will rest upon the ground, the sole itself will be turned inwards, and the upper end

of the lower fragment will be directed outwards, away from the tibia.

Signs when both are fractured. If both bones be broken, then the case will be evident enough from the change that may be noticed in the shape of the limb, an angular deformity being produced from the heel being drawn more or less backward and upward by the muscles of the calf; there will also be a shortening of the limb, and the foot will be twisted either inwards or outwards. Were any other circumstance necessary to indicate the nature of the accident, we have it in the very distinct crepitus, that may be felt without the least difficulty. When the fracture is situated at any point of the lower two thirds of the tibia, the fissure through the bone will frequently extend obliquely from above downwards and from behind forwards. Hence, the extremity of the upper fragment will be very sharp, and likely to protrude through the skin, making the case a compound fracture.

Treatment. The generality of fractures of the leg may be conveniently treated in the slightly flexed position, with the limb supported on M'Intyre's apparatus; or the leg may be placed on Amesbury's or some other double inclined plane, and supported with lateral splints. The bent position is by far the most comfortable to the patient, and it has the advantage of relaxing the powerful muscles of the calf. A few, however, are advocates for the extended posi-

tion, and amongst them Dr. Houston is most conspicuous; but notwithstanding his objections to the *bent* position, experience indicates that it is, generally speaking, the most advantageous for a broken leg.

Treatment of fractured fibula. Fractures of the upper part of the fibula generally unite without any permanent ill consequences, even though they may be neglected, and taken little care of. Many of them, probably, are never detected at all, in consequence of being unattended with displacement. But fractures of the lower part of the fibula require more caution; for if they are not rightly managed, the patient will sometimes be a cripple for life, the foot remaining distorted outwards, and the individual being obliged to walk on the inner malleolus, instead of on the sole of the foot.

Dupuytren adopts a simple and effectual plan for the treatment of those fractures of the fibula which proceed from a violent twist of the foot outwards. The whole of his apparatus consists of two rollers, a splint about two feet in length, and a pad stuffed with oaten chaff, much thicker at one end than the other. The pad is applied to the inside of the leg, with its thick end downwards, and then the splint is put on, which, by extending beyond the inner edge of the sole, makes a fixed point at a convenient distance from it, against which the foot is kept inclined

inwards by means of a roller. The splint is first secured on the part with a few turns of the roller round the upper part of the leg. If the fibula is broken by a twist of the foot inwards, Dupuytren applies the splint and pad on the outer side of the leg.

Treatment of compound fractures of the leg. Some fractures of the leg have been successfully treated with splints made on the principle of the fracture-box, the lateral parts of which admit of being let down, or put up, by means of hinges. Assalini's splints are thus constructed. If they are employed, the limb must then be kept in the extended position. Certain compound fractures are very conveniently dressed when such a splint, or a common fracture-box, is employed. In University College Hospital, M'Intyre's apparatus is commonly preferred to others, as being more simple, requiring no additional splint, keeping the limb perfectly steady, and, what is of high importance, allowing a great part of its surface to be uncovered, and the wound, if any be present, dressed, without the slightest disturbance of the fracture. Greenhow's apparatus likewise appears to be a highly meritorious one for the preceding objects, but is less simple and more expensive: with it the whole of the leg may be uncovered, and a wound dressed without moving the fracture in the slightest degree.

SECTION II.

FRACTURE OF THE HEAD OF THE TIBIA.

Management of. A fracture sometimes occurs obliquely through the head of the tibia and extending into the knee joint, in which a mode of treatment very similar to that recommended for oblique fractures of the condyle of the femur is necessary :—viz. an extended position of the limb, in which the extremity of the thigh-bone tends to keep the fractured portions of bone in their proper situation ; the application of a piece of wetted pasteboard, and a bandage. Passive motion should be employed early.

If not connected with the joint. If the fracture does not extend so high as the joint, the semiflexed position of the limb over a double inclined plane will answer best, as the weight of the leg then counteracts the efforts of those muscles, which otherwise would draw up the inferior portion of the broken bone.

SECTION III.

FRACTURES OF THE TIBIA AND FIBULA NEAR THE ANKLE JOINT.

Symptoms of fractured fibula. Fracture of the fibula frequently occurs about three inches above the outer malleolus.

The patient immediately experiences pain at the seat of the injury, which is much increased on attempt to bear the weight of the body upon the injured limb. In endeavouring to stand, he does not place his foot flat upon the ground, but rests it upon the inner side, so as to receive the weight of the body chiefly on the tibia; flexion or extension of the foot also augments his suffering. An inequality of the surface of the limb often exists over the seat of fracture, and a crepitus is readily distinguished, by placing one hand over the injured part, and, at the same time, rotating the foot with the other hand.

Causes. This fracture is produced by a blow upon the inner side of the foot, which forces it outwards against the lower part of the fibula; or, by a sudden and violent twist of the foot inwards. It is, perhaps, most frequently occasioned by a lateral fall, when the foot is confined. I* broke my right fibula by falling on my right side, whilst my foot was confined between two pieces of ice: I felt a snap in the bone at the time of the accident, and experienced pain from every jolt of the carriage in which I was conveyed home.

Treatment. The treatment necessary for this injury, consists in applying the many-tailed bandage, which is to be kept wet for a few days with spirit lotion; over this bandage, the padded splints with foot pieces are to be placed and secured, so as to support the

* Sir A. Cooper.

great toe in a line with the patella. The limb should be laid upon its side, resting on a pillow in a semi-flexed position...

Consequence of neglect. Although no great deformity can arise from the neglect of this accident, on account of the support afforded by the tibia, a considerable degree of lameness may nevertheless result, if the case be neglected. Dr. Blair, a naval physician, who had fractured his fibula, and had not paid proper attention to the case, became in consequence unable to walk on flat ground without a lameness ; the foot being twisted by the irregular union of the broken bone.

Fracture of the tibia. Fracture of the tibia often occurs at its inferior part, either extending into the joint, or seated immediately above it. If the fracture enters the joint, but little deformity is produced ; but if the accident occur above the articulation, the lower part of the upper portion of the bone usually projects a little. The foot is generally inclined somewhat outwards, but the injury is easily detected by the crepitus, which can be felt when the foot is freely moved.

Treatment. This injury should be treated in every respect as the former, but great care must be taken to prevent the inclination of the foot outwards, and to keep the great toe in a line with the patella. When the fracture takes place obliquely into the joint from within to without, the foot will be turned slightly

inwards, and the malleolus externus will project more than usual. It will be necessary, therefore, in the treatment, to attend to this point; in all other respects the treatment will be similar to that already prescribed. By placing the limb upon the heel, the proper position of it is more readily observed, but the case will do equally well, with attention, if the extremity be laid upon the outer side.

Compound fracture. The observations that have been made respecting compound dislocations of the ankle joint, will be found generally applicable to cases of compound fracture communicating with the articulation.

CHAPTER VI.

FRACTURES OF THE CLAVICLE.

Frequency of
the accident. **T**HE *clavicle* is probably the more frequent seat of fracture than any other bone in the body. For this there are several reasons. It is of frequent occurrence, because this bone serves two offices, which expose it to the effects of violence applied either to the shoulder or arm; in the first place, it keeps the scapula at the proper distance from the sternum, and, in the second place, serves as a point of support for the humerus, every impulse communicated to which bone is transmitted to it. It is therefore liable to fracture from violence applied either to the shoulder or arm. The superficial situation of the clavicle in front of the shoulder, across the upper part of the chest, must also expose it to injuries from blows, the fall of brickbats, or other violence applied directly to it.

The usual seat
of fracture. When the fracture happens from a direct blow, the injury may occur where the violence is applied; thus, if the blow has taken place towards that end of the bone which is nearest to the acromion, the fracture will occur at that point; if towards the sternal extremity of the bone, there will be the seat

of fracture. In such a case, the soft parts are always contused, sometimes lacerated ; and a *communited* fracture is generally produced. If the violence be great, the subclavian vessels and some of the nerves converging to form the axillary plexus, may be injured.

Fractures of the middle third of the bone are more frequent in their occurrence, and are commonly produced in a different manner. One office of the clavicle is to hold the scapula at a convenient distance from the sternum, so that the motions of the arm may have a due degree of freedom and extent. This disposition is one of the principal causes of the great frequency of fractures of the clavicle ; for, as this bone supports the scapula, every impulse and force transmitted to the shoulder is communicated to the clavicle, which, being slender, first bends and then breaks in its central part, just as a stick would break under a force similarly applied to it. In consequence, then, of the clavicle serving as a point of support for the scapula, and, in particular positions, for the whole of the upper extremity, it necessarily follows, that when a person falls upon his arm, in an extended state, the shock will be communicated along the humerus to the glenoid cavity of the scapula, and thence to the clavicle itself ; so that whether the person fall on his hand, shoulder, or elbow, the clavicle is likely to be fractured at its centre.

The degree of displacement. A material difference in fractures of the clavicle will depend on one particular circumstance; namely, whether or not the fracture has taken place on the sternal side of those two bands of ligament, which tie the coracoid and acromion processes of the scapula to the clavicle. If it has taken place on the scapular side of the coraco-clavicular ligament, it must be clear, that very little displacement can occur; because the outer fragment will be fixed by the ligament binding the clavicle to the acromion, while the inner one is prevented from quitting its place by the coraco-clavicular ligament itself. But when the fracture takes place within the latter ligament, or, in other words, on its sternal side, but external to the rhomboid ligament, which ties the inner end of the clavicle to the cartilage of the first rib, there will then be considerable displacement, because nothing prevents the outer fragment from being drawn down by the weight of the arm and shoulder, or from being carried forwards and inwards by the pectoralis major and subclavius muscles. Hence, whenever the fracture is within the coraco-clavicular ligament, the displacement must be downwards, forwards, and inwards. Another fact to be remembered is, that it is always the outer fragment that is really displaced; the inner one being prevented from quitting its natural level by the action of the sterno-cleido-mastoideus and pectoralis

major, which antagonise each other. When the fracture takes place on the outside of the coracoclavicular ligament, there is little or no displacement; and, if any at all occur, it is only in a trifling degree, such as may be produced by the outer fragment being slightly depressed, so as to slope downwards more than natural. In this case, if we take hold of the humerus, and push it directly upwards, we find that the outer fragment of the clavicle is brought to its proper level again.

Injuries to the soft parts. Some fractures of the clavicle are *comminuted*; this may happen when the injury has been produced by direct violence; and then the nerves converging to form the axillary plexus, are exposed to contusion and laceration. The late Mr. Earle recorded an interesting case of comminuted fracture of the clavicle, where these nerves had been so injured that paralysis of the arm ensued; and it was singular that the patient could not afterwards put her hand into moderately warm water without the effects of a scald being produced, characterised by vesications, redness, &c. The fact is curious, as proving the share which the *innervation*, or the nervous influence, has in enabling the different parts of the body to bear particular temperatures. When the clavicle is broken by a force applied to the outer part of the shoulder, the fracture is mostly oblique; and if the violence has been very considerable,

the end of the bone may protrude through the skin, and the case be *compound*.

Symptoms. When we first come to a patient whose clavicle is fractured, we usually find him sitting with his head inclined towards the affected shoulder, the fore-arm of the affected side bent and quietly supported on the other hand; a position which he spontaneously chooses, in order to relax the sterno-mastoid muscle and prevent all motion of the upper extremity, which would be exceedingly painful to him. There is a depressed and sunk state of the shoulder, more especially when the fracture is within the coraco-clavicular ligament; indeed, the shoulder will then be considerably depressed, and at the same time inclined towards the sternum; so that the space between the median line of the trunk anteriorly and the tip of the acromion will be remarkably diminished. An attentive practitioner will at once notice this approximation of the shoulder to the sternum. Then, if we pass our finger from the sternal extremity of the clavicle, regularly along that bone, we shall perceive, as soon as it reaches the situation of the fracture, a sudden depression in the line of the bone, arising from the circumstance already sufficiently explained; namely, the inclination of the external fragment downwards, inwards, and forwards. When we push the shoulder upwards, backwards, and outwards, so as to bring the external fragment into

its proper situation, a crepitus is perceptible ; or, even without elevating the shoulder, if the displacement is not so great as entirely to separate the two ends of the fracture from each other, a crépitus may be distinguished by putting our finger on the injured part and gently moving the humerus. Another sign of fractured clavicle is the patient's inability to put his hand to his forehead, because the humerus has now no fixed point of support, and is deprived of that fulcrum which the clavicle naturally affords it. This inability will always present itself, unless the fracture be on the outside of the coracoclavicular ligament ; in that case the patient may sometimes raise his arm, and imperfectly perform the movement referred to. In other instances, he cannot bring his hand into contact with his forehead, except by partly bending the fore-arm without moving the humerus, and partly by inclining the head downwards so as to make it meet the hand. Lastly, in consequence of the way in which the outward fragment is displaced, there is always a manifest prominence, occasioned by the end of the internal fragment,—the *rising end of the bone*, as it was termed by the old surgeons, who erroneously considered it to be above its proper level.

Treatment. In the treatment, we should always remember the direction of the displacement of the outer fragment, which is carried inwards, forwards, and downwards, while the internal one remains

in its natural situation ; indeed, the outer one may be situated directly under it. In order, therefore, to replace the external fragment, we should carry the shoulder backwards, outwards, and upwards, and take off the weight of the upper extremity. In this country, the contrivances used for the treatment of broken clavicles are, in nine cases out of ten, the sling and the figure of 8 bandage, with which the shoulders are braced backwards. A roller is passed round one shoulder, and then across the back to the other shoulder, round it, and then over the back again, crossing the first part of the bandage, and being continued in the form of an 8. But this bandage does not scientifically fulfil all the indications required ; and it even has a wrong operation ; for it tends to draw the shoulder inwards, or towards the sternum, as much as it inclines it backwards ; and the more tightly it is applied, the more it will force the shoulder inwards ; which, I need scarcely remark, is contrary to the proper object in view, viz., that of inclining the shoulder outwards.

Désault's mode of treatment. The French surgeons, who seem to have devoted great attention to the treatment of fractures, have contrived a method that is more judicious and efficient. Désault, the great surgeon at the Hôtel Dieu before Dupuytren, employed a cushion or compress, thick at the upper part, and thin below, or formed like a wedge. He put the thick end of this wedge-like compress immediately under the

axilla, and fastened it there by means of two pieces of tape passed over to the other shoulder. This compress, when the humerus is pressed close to the side, has the effect of throwing the head of that bone outwards; so that Désault, in truth, made the humerus a lever, with which he inclined the shoulder outwards, upwards, and backwards, and the wedge-shaped compress was his fulcrum. The elbow ought to be confined and supported in a sling, and kept close to the side with a bandage. Various mechanical inventions are sold for the cure of broken clavicles; but, so far as I can judge, if we understand the indications to be fulfilled, we shall always be able to accomplish every purpose with the aid of a compress, roller, and sling.

Boyer's mode of treatment. Boyer employs, first, a belt, which is buckled round the chest; secondly, a piece of dimity or quilted cloth, intended to be put round the arm, and furnished with four straps, by which the arm is fastened to so many buckles on the belt; thirdly, he employs a sling to support the forearm and elbow. When the fracture is within the coraco-clavicular ligament, greater attention will be necessary, than in other instances, to keep the displaced fragment upwards, outwards, and backwards, because the degree of displacement is more considerable.

If a young female of the higher class of society were to break the clavicle in the latter situation, she

should not merely be treated with mechanical means, but also be kept quiet, in the recumbent position, for two or three weeks ; because any deformity of the neck, caused by irregularity in the union of the bone, which it is often difficult to prevent without such precaution, would be a considerable disadvantage to her.

CHAPTER VII.

FRACTURES OF THE SCAPULA.

The parts most liable to fracture. THE greater portion of this bone is so deep, and so protected by thick muscles, that fractures of it rarely take place. The acromion is oftener broken than any other part, and next to that the lower angle. The coracoid process is sometimes fractured, but much less commonly than is generally believed ; and, I think, the same observation may be made with regard to the neck of the scapula, which is so strong and so well guarded from the effects of external violence, that a fracture of it is by no means a common occurrence. In some instances, portions of the glenoid cavity are broken off ; but this also is an event which is oftener talked of than really met with.

Fractures of its body. The body of the bone is but seldom broken. Its fractures may be perpendicular, but the greater number of them are transverse. Sometimes the scapula is fractured in more than one place ; and it may be broken in several pieces by great and direct external violence. Fractures of the body of the

scapula can only be produced by direct violence, as by a blow, a gunshot injury, or the passage of a heavy body over it. I know of no other way in which such an accident can happen ; and this fact explains why severe injury of the soft parts generally accompanies it. Sometimes the violence of the injury is such as to extend its effects to the thoracic viscera, and cause effusion of blood into the chest.

SECTION I.

FRACTURE OF THE ACROMION.

^{SIGNS.} When this process of bone is broken off, it is drawn downwards by the weight of the arm ; and the deltoid muscle, having in part lost its support, allows the head of the os humeri to sink as far as the capsular ligament will permit, and thus the roundness of the shoulder is destroyed. On tracing the finger along the spine of the scapula, towards the acromion, a depression is felt at the point of natural junction between these two parts. If the distance from the sternal end of the clavicle to the extremity of the shoulder be measured, it will be found to be lessened on the injured side. If the arm be raised from the elbow, so as to carry the head of the humerus upwards, the shape of the shoulder is immediately restored, in consequence of the acromion

process returning to its original position ; but the deformity recurs as soon as the arm is allowed again to hang down.

Diagnosis. When the arm has been thus elevated, a crepitus may be distinctly felt, by pressing one hand over the seat of injury, and at the same time rotating the elbow. In this manner, fracture of the acromion is best distinguished from dislocation.

Treatment. In the treatment of this accident, the os humeri should be made the splint, to keep the fractured bone in its proper position. To effect this, the elbow must be raised, and the arm fixed ; the bone will, by these means, be elevated to the inferior surface of the acromion, and if kept steadily in that position, will support the broken process and keep it in its place. A thick pad or cushion must then be placed between the elbow and side, to separate the former from the latter, and so relax the deltoid muscle, otherwise the broken extremities of the bone will not be brought in contact. The arm should, then, be bound firmly to the chest by a roller ; a second bandage or short sling should be applied to support the elbow, and this position be maintained for three weeks.

Union usually ligamentous. Very little inflammation usually follows this injury, and the disposition to ossific union is extremely feeble ; so that, unless the fractured ends of the bone be placed in close contact, and they be kept perfectly at rest during the time required for such

union, the junction will be ligamentous, and not ossific.

SECTION II.

FRACTURE OF THE NECK OF THE SCAPULA.

Like dislocation. This accident is much more likely to be confounded with dislocation than any other injury to which the bones of the shoulder-joint are liable. It takes place through the narrow part of the neck of the scapula, opposite the notch of the superior costa. The glenoid cavity, therefore, falls, with the head of the humerus, into the axilla; the rotundity of the shoulder is destroyed; a hollow exists below the acromion process; and the head of the os humeri may be felt in the axilla, as when dislocation into the axilla occurs.

Case. The nature of this accident is well illustrated by the case of a young lady, whose cervix scapulæ was fractured. The surgeon mistook it for a case of dislocation, and treated it accordingly. On the following morning he requested me to see the case, as the arm, he said, was again dislocated. On examination, the head of the bone was detected in the axilla, and the shoulder was flattened, giving the appearance of dislocation. By raising the arm at the elbow, the head of the humerus was immediately replaced, but instantly sunk into the axilla again on

the withdrawal of the support. Crepitus also was distinctly observable, on rotating the elbow with one hand, while I grasped the shoulder in the other. By placing a thick cushion in the axilla, and securing the shoulder in its natural position by a clavicle bandage, the fracture united in seven weeks, without deformity. The degree of deformity depends upon the extent to which a ligament, that passes from the under part of the spine of the scapula to the glenoid cavity, is lacerated. If this be torn, the glenoid cavity and the head of the bone sink deep into the axilla; but the displacement is much less, if this ligament remain entire.

Signs. In these cases the deformity of the shoulder is easily removed by raising the arm, but, when the support is withdrawn, the appearances of dislocation again present themselves; and by grasping the shoulder so that the fingers rest upon the coracoid process, a distinct crepitus may be felt when the arm is rotated. Thus the ease with which the form of the shoulder is restored,—the re-appearance of dislocation when the support is withdrawn,—and the perception of crepitus in the situation of the coracoid process, are the principal diagnostic marks of this accident.

Treatment. In the treatment of this injury, two principal points must be attended to. First, to elevate the head of the humerus; and, secondly, to carry it outwards. The latter object will be effected

by putting a thick compress in the axilla, which presses the head of the bone and glenoid cavity outwards ; and this position may be preserved by the employment of the clavicle bandage. The former, by elevating the arm and confining it in a short sling ; which, by raising the head of the humerus, supports the glenoid cavity and cervix scapula, and keeps it steadily in its place until union is effected. The time required for recovery, in adults, varies from ten to twelve weeks. In very young persons, all the motions of the limbs are restored in a shorter period, but it is a long time before the limb recovers its strength.

SECTION III.

FRACTURE OF THE CORACOID PROCESS OF THE SCAPULA.

When the coracoid process is fractured, a great deal of mischief is generally done to the soft parts of the shoulder, just below the clavicle ; for this fracture can only happen from great and direct violence. Hence the nature of the injury done to the bone is often concealed by the great degree of swelling which ensues. Hence also much of the treatment consists, at first, in measures for diminishing the swelling, as venesection, leeches, cold lotions, &c. The coracoid process, when broken off from the rest of the scapula,

is liable to be drawn downwards by the short head of the biceps, the coraco-brachialis and pectoralis minor, muscles connected with it ; they ought, therefore, to be relaxed. In one complicated instance, dissected by Mr. South, the coracoid process was broken, about half an inch from its tip, into two unequal pieces, the smaller of which remained connected above with the triangular ligament, and below with the short head of the biceps, which had pulled it down as far as the ligament would allow*. In the treatment, the shoulder should be kept quiet ; and this is effected by keeping the arm at rest with a sling and roller ; for if the arm be motionless, the shoulder will also remain quiet.

SECTION IV.

FRACTURE OF THE LOWER ANGLE OF THE SCAPULA.

When the lower angle of the scapula is broken off, it is displaced downwards and forwards by the action of the serratus major anticus. In the treatment of this accident, the humerus may be brought forwards across the chest, and the hand confined upon the opposite shoulder ; which position of the limb has the effect of bringing the fragments nearer together, and is the plan adopted now on

* J. F. South in Med. Chir. Trans. vol. xxii. p. 105.

the continent. But, in this country, when any part of the body of the scapula is fractured, we merely apply the spica bandage; the roller employed for which, after crossing over the scapula, is carried round the joint, and then over the back of the trunk, to below the opposite axilla, whence it passes in front of the chest to the injured shoulder, which it again encircles. The roller is conveyed in the direction here enumerated, until nearly the whole of it is expended, when it is made to conclude with a horizontal circle round the thorax. Such is the celebrated spica bandage, which is of little or no use; for it fulfils no particular indication, except the trivial one of retaining in its place the soap plaster, occasionally put over the injured part. The sling is indeed the only efficient part of the apparatus.

CHAPTER VIII.

FRACTURES OF THE HUMERUS.

THIS bone may be fractured at any point of its length; at its middle, either of its extremities, or above the insertion of the pectoralis major, latissimus dorsi, and teres major. Fractures of this bone may be transverse or oblique, simple or compound.

SECTION I.

FRACTURES OF THE HEAD AND NECK OF THE HUMERUS.

As these injuries often resemble dislocation, so as to lead to great mistakes in their diagnosis and treatment, I * have, in the following pages, brought together the observations which, in the course of my practice, I have had an opportunity of making concerning them.

Diagnosis. Every person who meets either with a dislocation or a fracture of the upper end of the humerus, has fallen upon the corresponding side of the body; but, the position of the limb, at the mo-

* Sir A. Cooper.

ment of the fall, has not been the same in both instances ; and this difference commonly determines the kind of injury which is to follow, and furnishes the means of recognising it. If, in falling, the patient separates his arm from the side, and puts out his hand to weaken the effects of the fall, the accident will be a dislocation of the head of the humerus, without fracture. On the contrary, if the arm be kept close to the side, as in an unexpected fall, or when the hand is confined in the breeches pocket, the weight of the body then acts upon the cushion of the shoulder, and if there is any displacement, it arises from a fracture of the head or upper part of the humerus.

If the case be a dislocation, the hand, having struck the ground, is usually marked by mud, dirt, abrasions, or ecchymosis : if a fracture, the violence having operated directly on the cushion of the shoulder, the hand is free from those appearances, and that part of the dress which covers the deltoid presents traces of having come in contact with the ground, or the skin of the shoulder exhibits marks of contusion. In dislocation, ecchymosis is situated at the internal and fore part of the arm : in fracture, it is upon the very cushion of the shoulder. In dislocation, ecchymosis is less frequent than in fracture.

In both accidents the acromion is prominent, but more so in dislocation ; the deltoid, in fractures, is shortened, and, as it were, swollen. In fracture, the

vacancy under the acromion is less than in dislocation, and the prominence in the axilla is much less. In dislocation, there is no crepitus, no ready movability of the limb, as in fracture. Dislocation requires greater efforts for its reduction than fractures; but, when reduced, it is sufficient merely to confine the arm to the side. In fracture, an apparatus is required to prevent the return of the displacement. A fracture without displacement, may be mistaken for a simple contusion; as the crepitus and mobility felt in the injured part, on rotating the lower portion of the humerus, are the only means of ascertaining the nature of the accident. Care, however, must be taken not to be deceived by the crackling or crepitus that is felt in examining the shoulder after a very severe contusion, which has produced inflammation of the articular surfaces and a deficiency of synovia.

Varieties of this accident. These accidents are of three kinds. First—Dislocations of the os humeri into the axilla, with fracture, and detachment of the head of the bone, which is thrown on the inner side of the inferior costa of the scapula. Secondly—Fractures through the neck of the bone, at the tubercles; in which the head of the humerus is broken off, but remains in the glenoid cavity. This fracture occurs at the epiphysis, or anatomical neck of the bone. Thirdly—A fracture below the articulation, between it and the insertions of the pectoralis major, latissimus dorsi, teres major, coraco-brachialis, and deltoid

muscles. This part has been called the surgical neck of the bone; but why, I do not know.

a. *Dislocation complicated with fracture.*

Causes. In the first accident, or dislocation with fracture, a person falls, and pitches with violence upon his shoulder, or a heavily laden carriage passes over it. By the first impression of the accident, the os humeri is dislocated; and by a second, the neck of the bone is broken, and the head, being detached, lodges in the axilla.

Signs. The signs of this accident are, the usual symptoms of dislocation of the os humeri into the axilla, the head of the bone being there felt; but with somewhat less hollow below the acromion, and behind the deltoid muscle, because the broken extremity of the shaft of the bone quits the fractured head, and becomes situated in the glenoid cavity of the scapula. Upon rolling the arm, the broken shaft of the bone can be perceived to move under the acromion. There is little power of motion; and considerable pain, not only in the shoulder, but in the arm and hand.

The head of the os humeri can be felt in the axilla, when the arm is raised and the surgeon's fingers are thrust into the axilla; but when the arm is rolled at the elbow, the head of the bone remains

entirely, unmoved, or very little obedient to the motion of the elbow.

In some cases, but not always, a distinct crepitus may be felt; more frequently, however, a gristly feeling, from friction of the broken neck of the bone against the glenoid cavity and its cartilaginous covering, is perceptible.

The broken end of the os humeri is drawn somewhat forwards; but is easily pushed into the glenoid cavity; from which, unless it be supported, it is again drawn by the pectoralis and coraco-brachialis muscles. The arm, measured from the acromion to the elbow, is shorter than the other.

As great violence has occasioned this accident, the parts are much obscured, by the effusion of blood, and by the inflammation which speedily follows: but, for the first three hours, the muscles are so lax, that, but for the pain it occasions, considerable motion of the limb may be produced.

I have seen many of these cases, as I believe, in the living; but I have dissected three of them, and therefore can describe them as they appear in dissection, as well as the character they bear during life. I gave one of the preparations to St. Thomas's Hospital, one to the museum at Guy's, and I have the other in my private collection.

Case 1. The first case was that of Mr. Blackburn, a West India merchant, who fell from his horse

at Enfield ; and when taken up, it was supposed he had dislocated his shoulder.

Mr. Lucas, sen. surgeon of Guy's Hospital, was sent for ; and after having made considerable extension, he thought he had succeeded in reducing the dislocation. Five weeks afterwards, Mr. B—— came to London, and consulted me. I found the common appearance of dislocation, the head of the bone being very perceptible in the axilla ; but Mr. B—— had suffered so much in the former extension, that he would not submit to any other trial. He could use his arm, when it was hanging by his side, in all the underhand directions ; but he could not elevate it himself, or suffer others to do it, and never could raise his arm above his head ; he suffered little pain or inconvenience, except in the elevation of the arm. He afterwards applied to Mr. Kitchener, a man formerly well known in our profession ; who, by constantly exercising the limb in various directions, obtained for him a considerable degree of motion. I attended him in his last illness, in June, 1824, with Mr. Arnott : and as he had promised me the dissection of his arm, I claimed it of his executors, and examined it with all the care of which I was capable.

Appearance on dissection. The deltoid, teres major, and coracobrachialis did not appear altered. The supra spinatus was somewhat wasted, as was the teres minor ; and their colour was fainter than natural. The

infra spinatus was put upon the stretch. The subscapularis passed over the head of the bone, and adhered to its cartilaginous surface. The capsular ligament had been torn, under the subscapularis tendon; but every other part was entire. The edge of the glenoid cavity remained; but its surface was rather ligamentous, than smooth and cartilaginous.

The head of the os humeri had been broken off. It was found in the axilla, behind the coracoid process of the scapula, strongly united to the inner side of the scapula.

The fractured neck of the shaft of the os humeri was seated in the glenoid cavity of the scapula, widely separated from the head of the bone; and its broken surface formed a new and good articulation with the glenoid cavity, being covered with a capsular ligament, which was, in part, newly formed. A ligamentous matter passed from the broken end of the os humeri to the inner surface of the glenoid cavity of the scapula.

The tubercles of the os humeri were connected with the broken extremity of the shaft of the bone, and not with its head; the greater-tubercle had become enlarged; and the tendon of the biceps still remained in the bicipital groove.

Case 2. I examined the body of Mr. Hollingsworth, who died of stricture in the urethra, and disease of the bladder and kidneys. When these parts had been traced, to see the changes which they had undergone, I said to the surgeon who attended him

with me, "Had he any accident, or other disease, to your knowledge?" and he answered: "Why, he once broke the neck of his scapula, for which I attended him; and he never recovered the use of his arm." Upon looking at his shoulder, I found it sunken, and altered in shape; and I observed that I thought I had seen the accident in living patients, but I never had an opportunity of observing the morbid appearances in the dead; and therefore, I said, "We must not neglect to look into this accident, and to add the fractured parts, as a preparation, to my collection."

Appearance on dissection. Upon inspecting the shoulder-joint, I found the neck of the scapula uninjured; but the head of the os humeri was broken from the shaft, and dislocated into the axilla; where it remained upon the inner side of the inferior costa of the scapula, to which it was firmly united: The tubercles of the neck of the os humeri were broken off with the head of the bone; and the fractured extremity of the neck of the os humeri was placed in the glenoid cavity of the scapula.

The underhand motions of the shoulder were restored; but the elevation of the bone, beyond a right angle, was strongly resisted, and even with difficulty could be accomplished in the dead body.

case 3. I have the preparation of a third case in my private collection, in which the effects of the accident during life were the same as in the two

former cases, and the appearances, on dissection, were as follow :

Appearance on dissection. The infra-spinatus and teres minor muscles were much wasted, on account of the arm having its motions in a great degree destroyed. The supra-spinatus and subscapularis muscles were less diminished ; as the little motion that remained, was performed principally by them. The tendon of the biceps flexor cubiti had been torn, but its remains adhered to the bicipital groove.

The head of the os humeri was broken off, and lodged on the sternal side of, and a little below the level of, the coracoid process of the scapula, where it rested upon the subscapularis muscle, and on the inner side of the inferior costa of the scapula. Here it was invested with a new capsular ligament, to which the axillary artery adhered ; but it was not joined to the scapula, as in the two former cases, and was only united, by a small process of bone, to the os humeri, at that part where it had been broken off.

The broken extremity of the os humeri was lodged in the glenoid cavity of the scapula, and had there formed a ligamentous joint.

Diagnosis. These, then, are the cases, which I have had an opportunity of dissecting, of this severe accident. The diagnostic signs, which distinguish it from simple dislocation in the axilla, are the following.—The fall and depression of the shoulder, in these cases, is less striking than in dislocation ; the shaft of the

bone filling up the glenoid cavity. The head of the os humeri may be distinctly felt in the axilla ; but as it does not roll when the os humeri is rotated at the elbow, this becomes the principal diagnostic mark. A grating sensation may generally be felt, and sometimes a very distinct crepitus, especially if the elbow be raised outwards during the rotation of the arm. The broken extremity of the shaft of the os humeri may be felt advancing to the coracoid process ; it is easily returned into the glenoid cavity, where it rotates with the arm, but easily slips forward again. The accident which produces it, is more violent than that by which simple dislocation in the axilla is produced ; and there is, therefore, a greater appearance of contusion, more swelling, and more pain.

Treatment. Extension is of no further use, than to bring the broken shaft cf the os humeri into the glenoid cavity, where it forms an useful articulation ; but no extension, however violent, disturbs the broken head of the bone, for no proper force could bring it into the glenoid cavity of the scapula. If reduction be ever effected, it will probably be by an extension with the heel or knee in the axilla.

To keep the broken end of the shaft of the bone in the glenoid cavity, a pad must be put in the axilla, to thrust it outwards : a clavicular bandage must then be applied, and the arm be supported in a sling. But let the surgeon do what he will, the head of the bone

will probably remain in the axilla, and the upper motions of the arm will, in a considerable degree, be lost.

Necessity of caution in the diagnosis. These cases should teach the members of our profession to be kind, generous, and liberal towards each other ; and not to impute, to ignorance or inattention, that which is the result of a generally incurable accident. It too often happens, that, when every trial has been made to restore the parts, and without success, the patient goes to some other surgeon, to whom he shews his arm, and points out its uselessness and want of motion. A jealous and illiberal medical man might say, " Yes, this is a dislocation which has not been reduced : I wish I had seen it at first ; but now it is too late for a successful attempt to replace it." However, every intelligent well informed surgeon will now confess, that no knowledge or exertion of skill, could have prevented the deformity and loss of the natural motion which results from this formidable accident.

b. Fracture through the Tubercles.

Its nature. This fracture happens at the junction of the head of the os humeri with the tubercles, just where the capsular ligament is fixed, and where, in young people, the epiphysis is placed. It is of very frequent occurrence in young people : it sometimes,

though more rarely, happens in the old : in middle age it seldom occurs.

Causes. In children it is the result of falls upon the shoulder ; or it happens from a sudden or unexpected push of the arm, while unprepared to resist it. I have seen it complicated with fracture of the clavicle : but this makes no difference in the treatment.

Signs. The signs of this accident are as follow :—The head of the bone remains in the glenoid cavity of the scapula ; so that the shoulder is not sunken, as in dislocation. When the shoulder is examined a projection of bone is perceived upon the point of the coracoid process ; and when the elbow is raised and brought forwards, this projection is rendered particularly conspicuous. By drawing down the arm, the projection is removed ; but it immediately reappears upon giving up the extension, and the natural contour of the shoulder is lost. The motion of the shoulder is painful ; the child cannot raise the arm but with his other hand : the elbow is with difficulty removed from the side ; and the arm is obliged to be supported, either by the patient himself, or by another person.

Diagnosis. The diagnosis of this injury is not difficult ; yet I have known the accident to be mistaken for dislocation. The point of the broken bone is felt at the coracoid process, and this is supposed to be the

head of the os humeri ; but, with care, the head of the bone may still be felt filling the glenoid cavity. When the elbow is rolled, the head of the bone does not obey its motion. A slight extension draws the broken point of the bone into the natural position, beneath the head from which it has been separated ; but it always reappears immediately, when the extension is lessened or removed.

Appearances on dissection. Upon the dissection of these cases, in the young, the head of the os humeri is found broken off at the tubercles, but it remains in the glenoid cavity. A great quantity of ossific matter is thrown out from the periosteum and fractured neck of the shaft of the bone, but very little from the broken head. A cup of bone is formed upon the fractured neck of the shaft, in one of my preparations ; which supports the head of the bone, so as to prevent the neck separating from it. A slight union is produced by the cancellated structure ; the principal callus being formed on the outer surface, and it encases the bone.

Its occurrence in old age. In old persons, this accident is comparatively rare : but the following is a case which illustrates it ; and I am indebted to Mr. Webster, surgeon, in the Edgware Road, for seeing the patient, and for giving me an opportunity of a post mortem examination of the shoulder.

Case. " Commander William Keppel, R.N., a stout, muscular subject, aged 77, residing at No. 4,

Queen Street, Edgeware Road, was violently thrown out of a street cab, on the 31st December, 1835. He could give no description of the accident; but it appeared that he fell upon the left side, the forehead being much lacerated, and the left shoulder seriously injured.

" On examination, half an hour after the accident, the power of the arm was found to be lost; the shoulder was enormously swollen, and its rotundity diminished. A depression existed in the belly of the deltoid muscle: a hard tumor, apparently, was felt under the clavicle, on the edge of the glenoid cavity, and those under the coracoid process. A crepitus was perceived, which was supposed to arise from a fracture of the scapular coracoid process. The arm was about an inch shorter than the sound one.

" The bones were replaced without very much difficulty, though the extension caused much pain. A bandage, wetted with spirit-lotion, was applied, and the arm placed in a sling. Enormous swelling and discolouration of the whole limb took place, accompanied with acute febrile symptoms, so that the bandage was obliged to be removed. Sixteen ounces of blood were taken from the opposite arm in the evening, and cold applications constantly used to the head. The violence of the symptoms gradually subsided; and in sixteen days the arm had resumed almost its natural size; although the swelling of the shoulder still remained, and the pain, on motion, was

so great, that the patient would not suffer any examination which could occasion the slightest disturbance of the limb. As the tumefaction diminished, there appeared a flatness on the upper part of the shoulder; and a large, hard tumour, like the head of the humerus, was distinguishable at the usual situation of the coracoid process. The patient positively refused to have any thing more done for him; for his pain was decreasing, and the use of the hand was returning.

"In the beginning of February, passive motion and friction were carefully employed; and in three weeks more, considerable motion had been regained. The arm, however, could not be raised to a level with the shoulder, nor could it be brought forward, across the chest. As each day elapsed, the condition of the arm improved; when, on the second of March, eight weeks after the accident, whilst walking in the street, the patient was seized with apoplexy, and died in a few minutes."

Appearance on dissection. Mr. Webster had the kindness to give me the parts of the injured shoulder, for particular inspection; and I have prepared a wet and a dried section of the injured articulation. The accident must have been of a most violent description, as the parts of the joint were absolutely comminuted. 1st. The acromion was broken off; and had formed a ligamentous union with the spine of the scapula, from which it had been separated. 2dly. The coracoid

process had been broken at its root; but was becoming again united, by ligament, to the scapula. 3dly. The head of the os humeri was broken through at the tubercles, or, as it is called, the anatomical neck. The periosteum of the neck of the bone, below the tubercles, had thrown out a considerable quantity of ossific matter, and united the broken shaft or neck to the head of the bone. The cancellated structure of the neck of the bone was beginning to unite the fractured head of the os humeri to the shaft of the bone.

Treatment. The best mode of treating these accidents consists, in the young, in applying a splint on the fore and back part of the arm, binding it on by a roller; placing a pad in the axilla, and using a clavicular bandage; supporting the hand, but not the elbow, in a sling; as, if the elbow be raised, the broken end of the bone projects forwards.

In old persons the injury is more severe, and the force producing it is violent: it therefore becomes necessary to reduce inflammation, and to apply leeches and evaporating lotions; to observe perfect rest at first: and, after some time, the same treatment, as to bandages, may be pursued as in the young.

In both the old and the young, passive motion is to be employed so soon as the union is effected: which, in youth, is in a month; but it requires from two months to twenty weeks, in age.

c. Fracture of the Cervix below the Articulation.

Its nature. The bone, in these cases, is broken in its surgical neck ;—between the tubercles and the insertions of the pectoralis-major, coraco-brachialis, latissimus-dorsi, teres-major, and the deltoid muscles.

Symptoms. In this case there is great deformity of the bone : the head, neck, and tubercles remain in the glenoid cavity, with part of the shaft of the bone connected with them ; but the broken end of the shaft is drawn forward and upward, under the pectoralis-major muscle. When the elbow is thrust upwards, the broken extremity of the bone projects on the inner side of the coracoid process of the scapula ; and it sinks when the support of the elbow is removed. When the arm is rotated at the elbow, the broken end of the lower part of the bone is felt to roll. There is very little, if any marked depression under the acromion ; and then it happens from the deltoid muscle being dragged down.

The extent of motion. The motion of the shoulder is extremely painful ; and the patient has generally one or more fingers affected, sometimes contracted, at others only painful : and this depends upon one or other of the nerves of the axillary plexus being irritated by a part of the bone. The elbow admits of being moved in all directions ; for there is much less confinement of the arm at the shoulder than in the

other accidents of that part: however, the movements are very painful.

Diagnosis. The diagnostic signs of this accident are the following;—the head of the bone remains in its cavity, and is unaffected by the rotation of the elbow; the point of the fractured neck may be felt under the pectoral muscle; and the surgeon is able to move the arm much more freely than in the other fractures of the neck of the bone.

Mr. Blenkarne, surgeon, of Dowgate Hill, has furnished me the following description of a case, in which the symptoms are exceedingly well marked.

Case. " Samuel Shenston, aged 71, (a patient of Mr. Blenkarne's,) residing at Valentine Place, Bermondsey, returning home on the evening of the 25th of March, 1836, was knocked down, and fell against the edge of the curb-stone. On being picked up, his right arm was found to be totally useless, and very painful.

" On the following morning I was sent for, to attend him; and on examination I found he had entirely lost the power of moving the arm from the side, and required it to be supported: the limb could not be straightened at the elbow: the little finger was quite drawn to the palm of the hand; and the next three fingers were more or less contracted: the thumb did not appear affected: there was numbness of the little finger and the two next, but not of the thumb and forefinger. The roundness of the shoulder was lost;

but, by lifting the shaft of the bone, it was restored. The hand could be raised to the head by assistance, but this was attended with excruciating pain. On rotating the limb at the elbow, a distinct crepitus could be felt. From the above symptoms, I was fully satisfied that it was a case of fracture of the neck of the os humeri. On the 28th instant, I requested my friend, Mr. Hilton, to see him with me; when he made a minute examination, and came to the same conclusion as myself.

"The following treatment was agreed on: a small pad was placed in the axilla; and the arm kept from the side, by a bolster-pad placed between the middle part of the humerus and the side of the chest, acting as a fulcrum. The arm was then confined to the side, by a roller passed round the body and limb; and the fore-arm slightly supported by a sling, which was continued for only two or three weeks. During the whole time of treatment he was confined to his bed. At the expiration of two months the bandages were removed. Being a man of feeble power, he then was directed to use the arm as much as possible, and employ friction. Ultimately, he recovered a tolerable use of the limb; so as to raise it to his head, and feed himself; to move it backwards and forwards; and to tie his drawers;—although the little finger, and the next to it, continued contracted. He survived the accident two years."

The bone, removed from this man after death, was presented by Mr. Blenkarne to the museum at Guy's Hospital.

Treatment. In the treatment of this accident, the splints, the clavicular bandage, and the pad in the axilla, are required : but, above all, it is necessary to permit the arm to hang by the side, unsupported at the elbow, so that its weight may be a constant source of extension upon the broken end of the bone.

Mr. Tyrrell's plan. Mr. Tyrrell informs me, that in a case of fracture at the tubercles, he found the bone was best maintained in its natural position by being raised and supported, at a right angle with the side, on a rectangular splint, one part of which rested against the side whilst the arm reposed upon the other part ; and until he made use of this plan, he could not succeed in removing the deformity, or in keeping the bone in its place.

Mr. Guthrie's case. Mr. Guthrie has given an interesting account of a curious case of fracture of the neck of the bone, in the Medico-Chirurgical Transactions *.

A man fell from a ladder, and received a severe injury on his shoulder. Mr. Guthrie saw him about three hours after the accident ; and the most remarkable and striking appearance was a fold or pucker of the skin, the size of half-a-crown, situated over the

* Vol. VIII. page 289.

pectoral muscle. A hard substance could be felt below; and extending, above it, to the coracoid process. He says, "I decided that it was a fracture, not a dislocation. The arm was moveable in every direction; and the elbow could be brought close to the side." After the swelling had subsided, he says, "I decided that the bone had been broken at its anatomical neck, and forced through the pectoral muscle."

He found that he could bring the bone down to its natural situation, as to length; but it would not exactly remain in its proper place.

The man recovered, with a good use of his arm; so that the case terminated very favourably.

SECTION II.

FRACTURES OF THE SHAFT OF THE HUMERUS.

Signs of. Transverse fractures of it, below the insertion of the deltoid, are attended with but little displacement, for the brachialis internus and triceps being attached, anteriorly and posteriorly to both fragments, counteract each other, and admit only of a slight angular displacement. Oblique fractures are always attended with displacement, whatever part be broken. The inferior portion, being drawn upward by the action of the deltoid biceps coraco-brachialis and long portion of the triceps, glides easily on the superior portion, and passes above its lower extremity.

Diagnosis. The shortening and change in the direction of the limb, the crepitus which may be very distinctly observed by moving the broken pieces in opposite directions, the pain, and impossibility of moving the arm, joined to the previous history of the case, render the diagnosis sufficiently plain.

Prognosis. In a simple fracture of the body of the humerus, the prognosis is favourable; but fractures near the elbow are liable to be followed by more or less stiffness of the joint, often very difficult of removal.

Treatment. In ordinary fractures of the humerus, some practitioners apply two pieces of soap-plaster, which together surround the limb, at the situation where the accident has happened: while others deem such an application useless. The practice is not adopted in University College Hospital. Extension, if necessary, being made by an assistant, who draws the lower portion of the bone downward, and at the same time bends the elbow; the surgeon is to apply a roller round the limb. Splints should then be applied;—one on the outer side, extending from the acromion to the outer condyle, and lined with a padding of tow, to prevent it hurting the limb from pressure; and another on the inner side, guarded in a similar manner, and extending from the margin of the axilla to a little below the inner condyle. Many surgeons consider these two splints to be sufficient; and indeed we place the greatest reliance on them.

As, however, the cylindrical form of the arm allows us conveniently to encase it in splints, it may sometimes be advisable to employ four splints; one externally, another internally; one anteriorly, another posteriorly. They are to be carefully secured, in their respective situations, by tapes; and the elbow and fore-arm is to be carefully and effectually supported, throughout the continuance of the treatment.

SECTION III.

FRACTURE ABOVE THE CONDYLES OF THE HUMERUS.

Like the dislocation backwards. When the condyles of the os humeri are obliquely fractured a little above the elbow-joint, the appearances presented are so like those occurring from dislocation of the ulna and radius backwards, that the two injuries might readily be confounded. In fracture, however, all marks of dislocation are easily removed by extension, but return again as soon as the extension is withheld; and, by rotating the fore-arm upon the humerus,* a distinct crepitus can usually be felt.

Case. In July, 1822, William Law, about nine years of age, was admitted into Guy's Hospital, having fallen from a cart upon his elbow. The arm was a little bent, and the ulna and radius appeared

to form a large projection behind the elbow-joint : when the fore-arm was extended, the appearances of dislocation subsided, but they returned immediately that the extension was discontinued. The arm was secured in splints, which were removed in ten days, when passive motion was carefully employed. The lad recovered.

Frequent in children. This injury is much more frequently met with in children than adults ; but I have known it to occur at nearly all ages.

Treatment. In treating this accident, the arm should be bent ; the fore-arm ought then to be drawn forwards to replace the fractured portions, and secured by a bandage in the bent position. A splint having two portions joined at right angles, is best adapted to this case ; the upper portion is to be placed behind the upper arm, and the lower part under the fore-arm ; a splint will also be required on the fore part of the upper arm. These should be well secured by straps, the arm should be supported by a sling, and evaporating lotions constantly applied.

Passive motion. After the lapse of a fortnight in the young patient, and of three weeks with the adult, passive motion should be carefully employed to prevent ankylosis, which may otherwise take place. In some of these cases, the loss of motion in the joint is considerable, even after the greatest care and attention on the part of the surgeon.

SECTION IV.

FRACTURE OF THE INTERNAL CONDYLE OF THE HUMERUS.

Signs of. The internal condyle of the humerus is frequently broken obliquely from the other condyle and body of the bone. When this accident occurs, the ulna, having lost its support, projects backwards, when the arm is extended, and presents the appearance of dislocation ; which disappears, on bending the arm. This injury may also be distinguished from others by the crepitus, which may be felt upon bending and straightening the arm ; from the hand being turned towards the side during extension ; and from the lower end of the os humeri advancing upon the ulna, so as to be felt upon the anterior part of the joint, when the arm is extended.

Cause. The cause of this accident is a fall upon the point of the elbow. It usually occurs in youth, before the epiphysis is completely ossified ; although I have seen it, but less frequently, in age. It is often mistaken for dislocation.

Treatment. The same mode of treatment as that directed for fracture above the condyles, will be proper in this case ; passive motion should be employed at the end of three weeks in the child, and a month in the adult, when the recovery will be complete. .

SECTION V.

FRACTURE OF THE EXTERNAL CONDYLE OF THE
HUMERUS.

Signs of. This injury produces swelling over the external condyle, and pain is experienced at the part on pressure, or during the flexion and extension of the arm; but it is best distinguished by the crepitus, which can be readily felt during the rotatory motions of the hand. If the portion of bone detached be large, it is displaced backwards, and the head of the radius accompanies it.

Dissection of. Two preparations in the museum at St. Thomas's Hospital, exhibit specimens of this fracture; one is oblique, and the other transverse at the extremity of the condyle. There is not any ossific union in either, but the fractured portions are joined by a ligamentous substance. And this appears to be the case in all instances of fracture within a capsular ligament; the vitality of the bone being supported merely by the ligament within the joint.

Frequent in children. Children are generally the subjects of this accident; it is seldom met with in adults, and very rarely in advanced age. It is occasioned, usually, by a fall upon the elbow.

Treatment. The best mode of treatment in this injury is, to place a roller around the joint, which

should also pass above and below it ; then to support the limb in a splint, having two portions at right angles, as in fracture above the condyles, to which the upper and lower arm are to be well secured. In young children, a portion of stiff pasteboard, applied wet, and bent to the shape of the elbow, will answer best, as when dry it adapts itself to the form of the limb, and affords an excellent support.

Passive motion. The splint is to be worn for three weeks, when the surgeon should, very cautiously, commence the use of passive motion ; it must be very gentle at first, and may be gradually increased, as the pain and inconvenience attending it subside.

Bony union. If the fracture in these cases extends without the capsular ligament, a bony union may, with care, be effected ; but when entirely within the capsule, the union, as far as I have seen, is always ligamentous.

SECTION VI.

COMPOUND FRACTURE AND DISLOCATION OF THE CONDYLES OF THE HUMERUS.

Not dangerous. I have known several cases of this nature recover, with a partial ankylosis of the joint ; if properly treated, the constitutional derangement in consequence of the injury, is not productive of any serious mischief.

510 COMPOUND FRACTURE AND DISLOCATION, ETC.

Case. A brewer's servant was admitted into Guy's Hospital, on account of a compound fracture of his elbow-joint, attended with considerable comminution of bone. The extent of injury was so great as to induce me to recommend immediate amputation, but I could not by any means persuade the patient to submit to the operation. The limb was therefore placed upon a splint, in a bent position, the bones being easily reduced ; and the edges of the exterior wound were carefully approximated. He recovered without any untoward symptoms, and retained sufficient motion of the joint, to enable him to resume his former employment.

I have known several other cases in which the patient recovered, without any severe constitutional suffering.

Treatment. In the treatment of this injury, the limb should be kept in a flexed position, as ankylosis to some extent is sure to be the consequence of it, when the position will lessen the inconvenience attending it. If attended with much comminution of bone, the loose portions should be removed before the external wound is closed. In elderly persons, or in those not possessing sufficient power of constitution to support the suppurative process, the limb should be amputated in the first instance. Otherwise the edges of the wound should be brought together by adhesive plaster, then covered with lint dipped in blood, and afterwards supported by a bandage moistened with an evaporating lotion.

CHAPTER IX.

FRACTURES OF THE BONES OF THE FORE-ARM.

THE fore-arm is more frequently broken than the arm, because external force operates more directly upon it, especially in falls upon the hands, which are frequent accidents. Bichat, in his account of Dé-sault's practice, mentions that fractures of the fore-arm often held the first place in the comparative tables of such cases, kept at the Hôtel Dieu. The fore-arm consists of two bones, the ulna and radius ; of which the latter is much more liable to fracture than the former, because it is articulated with the hand by a larger surface, and all the shocks, received by the hand, are communicated to it. The situation of the radius also more immediately exposes it to such causes as may break it. Both bones, however, are frequently broken together.

SECTION I.

FRACTURES OF THE RADIUS.

Most frequent
seat of fracture.

Fractures of the radius happen perhaps as often as those of any other bone in the body, except

the clavicle ; because it is articulated with the carpus, and has to receive all the force communicated to the hand in falling, and indeed on every other occasion. Another reason why the radius is oftener fractured than the ulna is, that the former is situated at the outer and upper part of the fore-arm, so that it is more exposed to the action of direct violence than the neighbouring bone. The majority of fractures of the radius take place in its middle third, or near the wrist ; and when the upper part happens to be broken, the injury is produced by a blow, or some species of direct violence.

Cause. When a person falls he stretches out his hand to save himself ; this part then comes violently in contact with the ground, and the force is immediately communicated from it to the radius, which bends and gives way generally in its central portion, but sometimes near the wrist, a fracture of the upper end of the radius rarely or never happening in this manner.

Signs of fractured radius. When a fracture of the radius is suspected, we should first inquire, whether the patient can, or cannot, perform the movements of pronation and supination of the hand ; for if he can do these well, then we may be certain that the radius is not broken. Or we may take hold of the patient's hand and rotate the radius for him, while the fingers of our left hand are placed upon it. If the bone is not broken, the upper portion of it will follow the movements of the hand, as it always naturally does ; but

if it is broken, considerable pain will be felt on attempting these motions of supination and pronation,—there will be a crepitus; and the upper fragment will remain motionless. In many instances there is displacement, the lower portion of the bone being in the prone position, and the upper in the supine one; and the fractured ends of both tending towards the interosseous space. There can be no alteration in the length of the bone or limb, while the ulna remains perfect, and serves as a kind of splint.

Fractures of the lower end of the radius. Fractures of the lower end of the radius deserve particular notice, as they are often erroneously mistaken for dislocation of the wrist. They may be either transverse or oblique. They usually occur from three to six lines, or an inch, from the articular surface. The resulting displacement will have a greater resemblance to dislocation, the nearer the fracture is to the wrist. Dupuytren met with some cases, in which the articular surface of the radius was comminuted. In general, fractures of the lower end of the radius take an oblique direction from above downwards, and from the dorsal to the palmar surface. Such fractures are mostly simple; but now and then compound. Occasionally, the lower fragment is split vertically into two pieces. In a few rare cases, besides a fracture of the radius, the ulna is dislocated, and projects through the skin.

Treatment. When the radius is broken, we should bend the elbow, and then make a little extension and counter-extension ; taking care to avoid pressing the ends of the fracture into the interosseous space. It is a grand point in the treatment to preserve the interosseous space perfect ; for, if we neglect this indication, the radius and ulna may grow together, and the motions of supination and pronation be for ever lost. Splints for the fore-arm, therefore, should not be jointed longitudinally, but be rather of a flat or trivially excavated shape ; and in particular, a tight bandage, which would depress the radius too much against the ulna, ought not on any account to be employed. Two splints are commonly put on ; and, after the reduction, either no roller at all should be applied directly to the fore-arm itself, or merely a slack one. Then one of the splints, properly padded or lined with soft materials, is to be laid along the inner part of the fore-arm, from the bend of the elbow nearly to the ends of the fingers, and another along the outside of this part of the limb. It is generally considered best to keep the radius nearly in the mid state between pronation and supination.

Diagnosis sometimes difficult. Sometimes, when the radius is broken near the wrist, and a good deal of swelling is present, we might be inclined to suppose the case a dislocation ; but generally there will be no difficulty in making out that the case is a fracture, for

(to say nothing of the rarity of such a dislocation) the nature of the injury is generally indicated by a crepitus, except in young subjects, in whom the case is often a mere separation of the epiphysis. We can also constantly feel the styloid process below the solution of continuity. In this case, if displacement occur, the lower fragment is mostly drawn backward by the action of the long supinator and extensor carpi radialis, but, in a few instances, it is drawn forward by the influence of the pronator quadratus. The reason of the greater frequency of the displacement backward is in some measure explained by the patient usually falling directly on the hand at the period of the accident, by which means the fragment is forced backwards. The fragments must be put into the proper position, and splints and a sling employed ; due care being taken to prevent the hand from inclining too much downwards.

SECTION II.

FRACTURE OF THE ULNA.

Cause. Fracture of the ulna is much less frequent than those of the radius, and occur most frequently at its lower extremity, where it is most slender and least protected, from the application of direct force to the fractured part ; as, for instance, when, in

a fall, the internal side of the fore-arm strikes against a hard resisting body.

Sym. On applying the hand judiciously to the inside of the fore-arm, the fracture is easily ascertained by the depression at that part, in consequence of the interior portion being drawn toward the radius by the action of the pronator radii quadratus. This displacement, however, is less considerable than what takes place in fractures of the radius. The superior portion remains unmoved.

Treatment. In this case, the assistant, who makes whatever little extension may be necessary, should incline the hand to the radial side of the fore-arm, while the surgeon pushes the soft parts between the two bones, and applies the apparatus, as in fractured radius. In all fractures of the bones of the fore-arm, and particularly in those which are near the head of the radius, a false ankylosis is to be apprehended, and should be guarded against by moving the elbow gently and frequently, when the consolidation is advanced to a certain point. In both accidents the fore-arm should be kept quietly in a sling.

SECTION III.

FRACTURE OF BOTH BONES.

Usual seat of fracture. This accident may occur, either at the extremities, or middle of the fore-arm. It is

frequent at the middle, very common at the lower end; but seldom at the upper part of it, where the numerous muscles, and the considerable thickness of the ulna, resist causes which would otherwise occasion the accident. This fracture usually occurs in the same line, but sometimes in two different directions; in most instances, it is single, occasionally it occurs in several points of their axis at the same time. Dé-sault, indeed, mentions a case, where the bones of the fore-arm were broken at their middle and lower portions into six distinct fragments; yet, notwithstanding they were quite detached, the middle fragments united very well, and with hardly any deformity.

Cause. This accident is most commonly occasioned by direct external violence; but, sometimes, it is produced by a counter stroke, which is generally the case when the patient falls upon his hand. In this instance, however, as the hand is principally connected with the lower broad articular surface of the radius, that bone alone has to sustain almost the entire shock of the blow, and hence is usually the only one broken.

Signs. The symptoms usually attending this accident are not likely to lead the surgeon into any mistake;—motion at a part of the limb which was previously inflexible;—a crepitus, almost always easily felt;—occasionally a distinct depression in the situation of the fracture;—occasionally a projection of the ends of the fracture beneath the skin;—pain on

moving the part ;—a noise, which is sometimes audible to the patient, at the moment of the accident ;—an inability to perform the motions of pronation and supination ;—and an almost constantly half bent position of the fore-arm.

Diagnosis. When this accident happens very near the wrist joint, it is apt to be confounded with dislocation of the radio-carpal articulation ; and, although this latter accident is exceedingly rare in its occurrence, it is necessary to be able to distinguish between them. These cases may be distinguished, by observing whether the styloid processes are above or below the deformity ;—or by simply moving the hand, if there be luxation without fracture the styloid processes will not change their situation, but if a fracture exist, they will follow the motion of the hand.

The nature and degree of the displacement.

The interosseous ligament, and the manner in which the muscles of the fore-arm are attached to these bones, render a displacement of the fragments, in the longitudinal direction, very difficult ; indeed, such displacement is seldom observed, and never in any considerable degree, being due, rather to the cause of fracture, than to muscular contraction. In transverse displacement, which is most frequent, the four pieces approximate, and the interosseous space is diminished or entirely obliterated near the seat of fracture, producing evident deformity of the part. There is likewise a degree of angular displacement always produced either

backwards or forwards, according to the direction in which the force has been applied.

Mode of reduction.—The fore-arm is to be bent to a right angle with the arm, and the hand placed in a position between pronation and supination. An assistant should then take hold of the patient's four fingers, and extend the fractured parts, while another assistant makes counter extension by fixing the humerus with both hands. The operator is thus enabled to restore the bones to their natural position, and to push the soft parts, by a gentle and graduated pressure on the anterior and posterior surface of the arm, into the interosseous spaces.

Treatment.—Boyer's mode of treatment, consists in applying two long and graduated compresses to the anterior and posterior sides of the fore-arm; their depth being proportioned to the thickness of the arm, increasing as the arm diminishes in diameter. A single-headed roller is then applied, of which three turns are made on the fractured part; it is then made to descend to the hand by coils partially placed over one another, and enveloping the hand by passing the bandage between the thumb and index finger, the bandage is again carried upwards in the same manner and reflected wherever the inequality of the arm may render it necessary. Two splints, of the same length as the fore-arm, should then be applied, one anteriorly, the other posteriorly; and these are to be secured by the remainder of the bandage, which is to be applied over them. Lateral

splints, in these cases, are worse than useless, because they would diminish the radio-cubital diameter, and, aided by the pronators, tend to push the ends of the fracture into the interosseous space.

The grand object to which the surgeon should more particularly direct his attention, is the preservation of the interosseous space; for if this space be destroyed, rotation will be altogether prevented. To accomplish this object, the splints and compresses should be applied in such a manner, that the soft parts may be forced into the interosseous space, and confined there during the progress of the cure. Boyer's longitudinal compresses are not, generally, resorted to in England; care being taken not to let the circles of the bandage on the fore-arm be too tight, which would have the injurious effect of compressing the ends of the fracture into the interosseous space.

If the fracture be simple, and the contusion inconsiderable, the patient need not be confined to his bed, but may walk about with his arm in a sling.

SECTION IV.

FRACTURE OF THE CORONOID PROCESS OF THE ULNA.

Sigⁿs. The following case, which I have for many years related in my lectures, was considered as

a fracture of the coronoid process, and will show the symptoms produced by such an injury.

Case. A gentleman, in the act of running, fell upon his hand, which he had extended to break his fall; on rising, he discovered that the motions of his elbow joint were greatly diminished, as he could bend the arm but little, nor could he entirely straighten it. His medical attendant in the country, to whom he applied, found the ulna projecting considerably backwards, but that, on forcibly bending the arm, the figure of the joint became immediately restored. A splint and bandages were applied, and the arm supported by a sling. Several months afterwards, the gentleman came to town, when I saw him, and shewed me his arm; the ulna still projected behind the condyles of the humerus; but could with very little violence be restored to its natural situation by bending the arm.

Appearances on dissection. Some time after I had seen this gentleman, I had an opportunity of dissecting a case of this injury, in a subject brought to St. Thomas's anatomical theatre. The coronoid process of the ulna had been broken off within the joint, and had only united by ligament, so as to move freely on the ulna, and alter the sigmoid cavity of the ulna so much as to allow that bone to be carried back between the condyles, when the arm was extended.

Union mostly ligamentous. I am doubtful if the most careful treatment would effect a perfect cure, as the coronoid

process loses its ossific nourishment, and has only a ligamentous support. The vitality of the fractured process of bone is only supported by the vessels of the reflected portions of the capsular ligament, which do not appear sufficient to create a bony union; nor is any change on the surface of the bone apparent.

Treatment. In the treatment of this accident, the arm should be kept steadily in the bent position for three weeks, to allow time for ligamentous union, and to make it as short as possible.

SECTION V.

FRACTURE OF THE OLECRANON.

Symptoms. This process of the ulna is not unfrequently broken off, but the marks of this injury are generally so evident, that it can scarcely be mistaken. A swelling takes place at the back of the elbow, which, when pressed, feels soft, and allows the finger to sink in towards the joint, between the two extremities of the fractured bone. The detached portion is drawn upwards from the head of the ulna, to the extent of from half an inch to two inches; it can be readily moved from side to side beneath the integument, and becomes further separated from its former connection when the arm is bent. The patient can bend the arm with ease, but he cannot extend it without great difficulty, and the

attempt gives him much pain; if the limb be undisturbed, it remains in a semiflexed position. No crepitus can be felt; and the rotatory motion of the radius upon the ulna remains perfect. Considerable tumefaction from effusion of blood usually follows this accident, and in a few days the surrounding parts are much discoloured from ecchymosis.

Appearance on dissection. The fracture generally occurs about the centre of the process, transversely; but I have seen the bone obliquely fractured. That portion of the olecranon, which is still connected to the ulna, exhibits some evidence of ossific deposit, and sometimes the detached part presents some very slight marks of a similar character. The cancellated structure of the fractured olecranon is filled with new ossific matter, and is sometimes smoothed by occasional friction. The capsular ligament is lacerated posteriorly on each side of the olecranon; which is separated to the extent of from half an inch to two inches from the ulna, and united to it by a ligamentous band which is stretched from one broken extremity of the bone to the other.

Nature of the injury. It appears, therefore, that as soon as the fracture takes place, the action of the triceps muscle draws up the extremity of the process, to the extent of from-half an inch to two inches, according to the extent of laceration of the capsular ligament, and of that portion of ligamentous band naturally connecting the olecranon to the coronoid process. I

have, however, seen this process united by bone, when the fracture has happened near to the shaft of the ulna.

Experiments. To satisfy myself whether this process when broken would again unite by bone, I tried several experiments upon dogs and rabbits. In these experiments, I found that if the fracture was transverse, and such as to allow of separation, between the fractured ends, by the action of the muscles, the union was always ligamentous. If the fracture was oblique, and not admitting of separation, the parts were readily united by ossific deposit. The want of bony union appears, therefore, to depend upon a want of adaptation of the broken surfaces ; and not upon any deficiency of support, as in the case of fractures of processes within the capsular ligaments of joints. The ligamentous substance, which forms the bond of union in these cases, is often incomplete ; having an aperture, and sometimes several apertures, in it, when it is of considerable strength. The arm is weakened in proportion to the length of the ligament, which necessarily diminishes the power of the triceps.

Causes. This fracture may be occasioned either by falling upon the elbow, when the arm is bent, —or, secondly, it may take place from the action of the triceps muscle only, during any violent and sudden exertion of the arm while in a flexed position.

Treatment. The principle of treatment in these cases is to render the separation of the fractured extremities of the bone as slight as possible ; the limb being weakened in proportion to the length of the ligamentous union, on account of the diminished power of the triceps muscle. The arm, if possible, should be placed and fixed in a straight position, and if much swelling and pain exist, leeches and evaporating lotions must be employed for two or three days ; and as soon as the tumefaction has subsided, a wetted roller must be applied above the elbow, and another below, having a portion of linen or broad tape placed beneath them longitudinally on each side of the joint ; the ends of these pieces of linen or tapes are then to be tightly tied over the rollers, so as to approximate them, and thus bring the broken surfaces together. A splint well padded must be placed on the fore part of the arm and joint, and confined by rollers, so as completely to prevent any flexion of the limb. The bandages about the seat of injury should be kept wetted with the evaporating lotion. If there be much swelling and contusion, it is right to apply leeches and evaporating lotions, for a few days prior to the application of bandages ; but if the violence done to the soft parts be only trifling, then the bandages may be applied at once.

Passive motion. In this, which is the only injury occurring to the elbow joint, where the straight position is proper, passive motion should be very care-

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fully employed about a month after the accident ; but if it be attempted sooner, the olecranon will separate from the shaft of the bone, and so weaken the ligament.

Compound fracture of the olecranon. When this fracture is compound, union by adhesion should be effected if possible, by approximating the edges of the external wound with adhesive plaster, and placing over it lint dipped in blood ; the treatment in other respects will be the same as in the simple injury.

SECTION VI.

FRACTURE OF THE NECK OF THE RADIUS.

Very rare. This injury, which is said by some surgeons to be of frequent occurrence, I have never seen ; but I do not mean to deny that it sometimes happens.

Diagnosis. When it exists, I should imagine that it would be readily detected by the crepitus, which would occur on fixing the external condyle of the humerus, and, at the same time, rotating of the radius.

Treatment. The same mode of treatment as that already recommended for fracture of the external condyle, would in such cases be most proper.

CHAPTER X.

FRACTURE OF THE METACARPAL BONES, OR PHALANGES.

THE metacarpal bones of the little finger and thumb are more frequently broken than the other three. Fracture of the metacarpal bones is generally produced by violence directly applied to the part; as no force, capable of causing the accident, can well act upon the two ends of the bone so as to break it. The fracture may be simple, but more commonly it is compound, the soft parts being wounded and lacerated by the same violence which has injured the bone. In most cases, also, unless the force has operated on a very limited surface, more than one metacarpal bone is fractured.

Fracture of its digital extremity. The digital extremity of a metacarpal bone, which is called the head, is sometimes broken off, and gives rise to an appearance of dislocation; but the crepitus, on examination, makes the nature of the accident very evident.

Treatment. In the treatment of this accident, the patient should be made to grasp a large ball of firm materials, and over this his hand should be confined by a roller; this is the best method of restoring the

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fractured bone to its natural position. If the fracture be compound, the same mode of treatment must be employed as that which is necessary for injuries of the carpus.

Fractures of the phalanges. In fractures of the finger bones, the treatment consists in applying pasteboard, or in placing the hand on a flat splint or finger board, and keeping the part at rest in a sling.

INJURIES OF THE HEAD AND SPINE.

CHAPTER I.

INJURIES OF THE HEAD. :

BEFORE proceeding to an examination of those injuries which the bones of the head and spine are liable to, and which possess peculiar interest, both on account of the delicacy and importance of the viscera they protect, and the character of the symptoms which accompany them, it will be profitable, very briefly, to survey the functions of the nerves and central organs of the nervous system. This will serve to recall that extended knowledge, which can only be acquired by assiduity in the dissecting room and hospital, and is especially necessary in the examination of these injuries.

The central or-
gans. The central organs of the nervous system, consisting of the brain (which is divided into cerebrum, cerebellum, and medulla oblongata) and spinal cord, form the connecting medium between all the nerves, or conductors of nervous influence. They act as excitors, or motors of nervous action, in determining the motor nerves to the production of contraction in muscles: and in this their action may

either be automatic or voluntary ; in the former case, it may be constant or intermittent ; in the latter case, it is the consequence of incitements of the sensorium commune seated in them. Moreover, the central organs have the power either of reflecting the centripetal actions of sensitive nerves upon motor nerves, or of communicating them to the sensorium commune, the seat of consciousness. By the central organs, too, the organic actions of the nerves are maintained in unimpaired power ; by them the nervous principle is constantly generated and regenerated ; and without them the power and excitability of the nerves, as conductors of nervous action, cannot long be preserved.

The nerves. The nerves are freely distributed to every part of the human frame, and are the means by which all voluntary and involuntary motions are produced. It is impossible that a mere description of the nervous system, in this place, however minute it might be, could make one sufficiently acquainted with its anatomy ; for this can only be obtained by the most careful and attentive examination of the dead body. It is necessary, however, to bear in mind, that an immediate communication exists between the stomach and brain, by means of the eighth pair of nerves, or par vagum ; for unless this be done, it is probable that an important symptom, which I shall presently mention, attendant on injuries of the brain, will be but imperfectly under-

stood. Another circumstance connected with the brain and particularly deserving of attention, is the fact of its being the medium through which the mind acts. The mutual influence of the brain and mind on each other will be amply demonstrated as I proceed.

Signs of injuries of the brain. When the brain receives an injury, the symptoms stated to be the result of that injury are —general loss of sensation and volition, if the injury be considerable ; but if the injury be less severe, some portion of sensation and volition will remain. For example, when called to the bedside of a person thus situated, he is found to be comatose ; if spoken to sharply, he becomes roused for the moment, mumbles some brief answer, again lies down, and relapses into his former sleepy state : so that the mental faculties and volition still partially remain. This state should be minutely noted, as it will greatly assist the after diagnosis ; and the surgeon must take care that he is not deceived, for a man in this condition very much resembles one in a state of intoxication ; a similitude which often proves exceedingly harassing to the surgeon. He is probably sent for to a person who, it is stated, has received a severe injury of the head. He finds him with a very severe laceration of the scalp, together with stupor, and sometimes even stertorous breathing. Not knowing that the individual was intoxicated at the time of receiving the injury, the surgeon attributes the above symptoms to

concussion or compression, when, after a few hours, the person recovers from his drunken fit, and it becomes apparent that he received no other mischief than a wound in the scalp.

In addition to loss of sense and motion, the fæces involuntarily pass off, and the urine is retained; in consequence of the sphincters of the rectum and bladder losing the controul of the will, which, to a certain extent, regulates their action. And the surgeon is obliged to pass a catheter for the removal of the urine at the very time when the escape of the fæces cannot be controlled. But the functions of the stomach are sooner affected by injuries of the brain than those of any other organ, arising from the nervous connexion before mentioned; vomiting, therefore, is one of the first symptoms. Though the fæces pass involuntarily, yet there is such torpor of the intestinal canal that purgatives will not easily excite action, and there will be found considerable difficulty in procuring evacuations. The pulse is said to beat laboriously; for the heart being affected, it cannot readily get rid of its contents; it is not slow, however, unless the body be at rest: for upon the slightest exertion, it becomes exceedingly quick. The pupils are dilated. There is sometimes bleeding from the nose, which, when the patient has been kept lying on his back, often occasions vomiting of blood. When the injury has extended to the basis of the skull, producing

fracture there, it is generally attended with bleeding from the ears. Such cases are very dangerous, and persons usually fall victims to them. In addition to the symptoms already enumerated, there is often partial paralysis, or hemiplegia; squinting is occasionally produced, the natural direction of one or both eyes becoming changed; permanent, partial, or total aberration of the mental faculties may also be added to the consequences already enumerated, arising from injuries of the brain.

Differences between concussion and compression.

The differences between concussion and compression, may be stated briefly thus. Concussion is simply a shock, more or less severe in its nature, which the brain has received, with or without laceration of its substance. Compression, on the contrary, arises either from a depressed portion of bone, the extravasation of blood, or the formation of matter: and, from whichever of these it springs, the symptoms will be the same.

SECTION I.

NATURE AND SYMPTOMS OF CONCUSSION.

Symptoms of concussion.

In describing the symptoms and treatment of these diseases more particularly, I will first begin with *Concussion*. When called to a person in a state of partial stupefaction, with regular pulse, tranquil and regular breathing, and the accident has

existed some hours, the surgeon will generally be justified in pronouncing that the injury has been trifling. But when the individual has been first seized with vomiting, is incapable of using any muscular power from loss of nervous influence, and there is a total aberration of the mental faculties, with intermittent pulse and breathing ; these will be diagnostic symptoms of severe injury, and the case is a dangerous one. In simple concussion, where the derangement is not so extensive as that just described, where the patient, upon being spoken to, raises himself, as if awoke from a sound sleep, and some power of volition still remains, the accelerated action of the pulse through the patient exerting himself, will be found to be one of the best diagnostic symptoms. A man in this state, with a pulse at 70, on being raised or attempting to walk, will have it inordinately quickened, beating 130 in a minute ; this is a never failing symptom, and where the patient can be made to exert himself at all, will be found a sure characteristic of the disease. There is also in these cases a greater action of the carotids than in health ; they beat more violently, though not more quickly, if the patient be at rest. If asked what are the best marked symptoms of concussion, I should say, this increased motion of the carotids ; the apparent tranquil sleep ; the instantaneous relapse to that state after having been

roused ; the remarkable excitement of the pulse upon using exertion, and insensibility immediately following the injury.

^{Loss of con-} The diminution of the operations of the mind is often so great in concussion, even where considerable voluntary motion remains, that one cannot, even by hallooing as loudly as he is able, get any other answer from his patient, than 'eh!' delivered in a gruff under-tone. I have known several very curious circumstances of this kind. One case was that of a gentleman who had met with an injury of the head, by which concussion had been produced ; every endeavour to get a word from him was ineffectual ; yet at one period, when the attendants were all absent, he got out of bed, bolted the door, made water, and returned to bed again, in the same manner as though he had been in perfect health. When the servant went back, he found the door fastened ; all their knocking was unavailing ; they were obliged to break it open, and then could not procure from him a single word. Indeed, I do not believe the noise of an earthquake would have succeeded in rousing him from his lethargy ; yet he could get out of bed, pass his urine, and adopt his ordinary habit of delicacy, by bolting the door.—I have caught a man when labouring under the effects of concussion, with his feet in a chamber-pot, and by the action of his hands, it was evident that he was trying to throw water over his legs ; upon the servant

going into the room of the same individual some days after, he was found to be attempting to shave himself, and having no lather, he substituted a pot of spermaceti ointment, which he had brushed all over his face.

^{Its effect on} memory. Most people have heard of the extraordinary change which the memory sometimes undergoes from the effects of concussion. The first story of this kind that I ever heard was from Mr. Cline. A man was taken to Guy's, in a state of insensibility, in which condition he remained for some time, but at length recovered ; and when he did so, no person in the hospital could understand his language ; a milk woman happening to go into the ward one day, heard him, and discovered that he was speaking Welch ; he told her that he knew English well before the accident, but after it, all knowledge of that language was obliterated from his mind. It had been recently acquired ; the impression was less strong, and, consequently, the more easily effaced. I witnessed a similar circumstance in the case of a German, who was a sugar-baker in this town, and who had compression of the brain, arising not from any injury by violence, but from pressure in consequence of the formation of matter. This man could speak English extremely well before the compression ; but as the compression increased from the accumulation of matter, he lost his English entirely, and I could only communicate with him through the

medium of an interpreter. At last he lost the power of speaking even in his native language, and died in consequence of the accumulation of matter.

It is curious to observe the gradual change which takes place in the intellectual faculties, as alterations occur in the brain, and the gradual diminution of ideas which have been more recently acquired, until at length they become totally obliterated. Old persons are observed to be fond of relating anecdotes of their youth, forgetting incidents of more recent occurrence; and the change which takes place in the intellect, from injuries of the brain, is very similar to the effects of age. The patient becomes, as it were, suddenly old, loses impressions of a recent date, and is sensible of those only which he has received in his earlier years. Such is the state of mind very frequently produced by compression of the brain.

Effect on the cerebral circulation. With respect to the state of the brain under concussion, when the concussion is not extremely violent, there is merely a change in the circulation of the brain. A sudden shock will so far disturb the circulation of this organ, as to produce diminution of the powers of the mind, as well as to impair the functions of the body. I shall have occasion to mention a most extraordinary case, in which the functions of the mind were suspended from an interruption of circulation in the brain, for upwards of thirteen months; the patient having, as it were, drunk of the cup of Lethe during all that

period. Any change of the circulation in the brain alters, in some degree, the powers of mind and body; but if the agitation be very considerable, the powers of the mind will, for a time, be suspended. Thus, when a person is said to be stunned, there is a sudden alteration of the circulation in the brain, and a corresponding loss of sensibility; but when the circulation is restored by means which I shall hereafter indicate, the powers of the mind return with those of the body.

Lessons of the
brain. When the concussion is very violent, a lesion of the brain takes place; but when it is slight, no appearances can be discovered, on dissection, which indicate any alteration of structure. A person may die from another injury, accompanied with concussion; and, on examination after death, not the least alteration may be found in the brain. This is not the case, however, where the concussion is violent. I have a great number of preparations, from the brains of patients who have died of concussion, in most of which that organ was considerably lacerated, and, in some, extravasation of blood is observable within the brain.

Case. I remember the case of a gentleman, an intimate friend of the late Lord Nelson, who fell from his horse at the corner of St. Thomas's Street, in the Borough. He was immediately taken to Guy's Hospital, where, on examination, he was found to have all the symptoms of concussion, and

was treated in the usual manner. He died eight days after the accident. On examination of the body, after death, the brain was found to be lacerated in several places, and considerable extravasation of blood had taken place. In general, therefore, when the concussion is slight, there will be only an alteration of circulation in the brain ; but, when it is severe, there will be laceration, accompanied with extravasation of blood, and the symptoms will be found to run into those of compression.

Case. The first case in which I ever saw the brain lacerated from concussion, was one which occurred at the other hospital, in the first year of my apprenticeship, when I was a dresser to Mr. Chandler. As this was the first case of the kind I had seen, I preserved a portion of the brain. The patient had lost the power of speech from a blow on the head ; but there was no appearance of any wound or injury to the skull. Mr. Chandler attributed the loss of speech to concussion. On examination of the body, after death, it was found that the anterior lobe of the cerebrum was torn, the first effect of which injury was the loss of the power of utterance, or rather a paralysis of the muscles, which deprived him of the power of speech, and subsequently compression and inflammation, of which he died.

When the question is asked, then, as to the effects of concussion, as they may be collected from the appearances on dissection, it may be answered by saying

that, when the concussion is slight, it is merely an agitation of the brain, by which the circulation is altered ; but when it is severe, the brain itself suffers laceration, which laceration is accompanied with extravasation of blood. By the knowledge of these facts we are led, without difficulty, to the principles of treatment.

SECTION II.

TREATMENT OF CONCUSSION.

Bleeding. The great danger which we have to guard against, in the treatment of concussion, is inflammation of the brain. This principle must direct our practice ; and, in order to prevent inflammation, we must take away a very considerable quantity of blood. By bleeding largely at first, we not only remove existing inflammation, but prevent that which would otherwise occur. This practice, however, may be carried to excess. There are some persons who say you cannot bleed too much in these cases ; but such an assertion only proves their want of understanding. The surgeon must regulate his conduct by the symptoms ; he must observe whether there be any hardness in the patient's pulse, and whether he complains of pain in the head, if he have still the power of complaining ; he should watch his patient with the greatest possible anxiety, visit him at

least three times a-day, and, if any hardness of the pulse supervenes after the first copious bleeding, take away a teacupful of blood; but do not go on bleeding him largely, for, by this means, the strength of the patient would be reduced too much, and prevent the reparative process of nature. It is necessary that there should be a slight degree of inflammation, for without this the reparative process cannot go on, and the patient cannot recover; but it will be your duty to keep this inflammation within due bounds.

Danger of excessive bleeding. I shall mention a case in which fatal consequences ensued, from the surgeon bleeding his patient to such excess that the slight degree of inflammation, necessary to the process of adhesion, was removed, and the reparative process of nature consequently prevented. I feel it to be my duty to describe surgery as it is, and not in the glowing colours in which it is painted by many. We ought to be content to practise surgery as it is—not as it is sometimes fallaciously represented. I am most anxious, therefore, to omit nothing which may contribute to increase the professional skill of my reader, and enable him to afford the greatest possible sum of relief to his patients. But they who blazon forth our profession as one which is attended with undeviating success, commit a serious error. To form a correct judgment what the profession really is, we must hear the untoward cases as well as those of which the issue is favourable. For these reasons I shall never hesi-

tate, *coute qui coute*, to detail those cases which have terminated unfavourably. I have a duty to perform, and I shall never shrink from the discharge of it. It is by detailing the unfavourable as well as the favourable cases, that I can alone perform that duty ; for it is by such a course alone that I can point out the rocks which are to be avoided, as well as the havens where we are to endeavour to anchor.

Case. The case to which I allude was one of concussion, accompanied with slight laceration of the brain, which occurred in the other hospital. The gentleman under whose care the patient was, thought it right to bleed him, and that he could not bleed him too largely. He accordingly bled, not only from day to day, but twice a-day. The consequence of this mode of treatment was, that the patient became perfectly pale, was in a state of considerable dejection, not of the mind, but of the powers of the body, and died without any symptoms of inflammation, ten days after the injury. On examination of the body, it was found that there was a slight laceration of the brain, with some degree of extravasation of blood, but that not the slightest attempt had been made by nature to heal the wound. The brain heals, like any other organ, by the process of adhesion ; but, in this case, the quantity of blood taken from the patient was so large, that the slight inflammation necessary to the adhesive process was removed, and the process of restoration consequently prevented.

* Repeated bleed-
ing sometimes ne-
cessary.

Still, it is often necessary to take away blood after the first large bleeding ; but it must be taken in small quantities, and the patient must be watched with the greatest possible anxiety, for the symptoms alone can regulate the practice. Sometimes it is necessary to take away large quantities of blood. I was called to a gentleman who had fallen from his horse in riding to London. I found him insensible on my arrival. Mr. Constable, who attended him, had already bled him, but I judged it necessary to bleed him again largely, and I took blood in smaller quantities from him day after day, watching the pulse with the greatest anxiety, and bleeding him only so far as to reduce the hardness of the pulse without diminishing too much the powers of his body. The whole quantity of blood taken from this gentleman, by bleeding from the arm, opening the temporal artery, and the application of leeches, as far as this could be estimated, amounted to about two hundred and eight ounces of blood. One hundred and eighty ounces were taken from the arm alone ; yet such was the hardness of the pulse, that at the last bleeding there was some degree of inflammation of the brain indicated.

Proper time for
bleeding.

Bleeding is employed as a means for preventing inflammation : but it must not be resorted to by the surgeon, the moment he is called to a patient under concussion, as a matter of course. A man falls from his horse, and the instant he is picked up from the ground, some surgeons think it necessary to

take the lancet from their pocket. This conduct is quite irrational; for suppose the pulse could scarcely be felt at the wrist of the patient, and the surgeon were in such a case asked why he proceeded to bleed; what would his answer be? The probability is, that he would have no answer at all ready; or he would, perhaps, say that he bled him because the accident had brought a great quantity of blood to the brain, as if the shaking of the head could have any effect in producing a determination of blood to the brain. It is not with this view that we bleed in concussion, but in order to prevent inflammation. I have seen many a patient who would have died if a large quantity of blood had been taken at the time of the accident.

Cases. This was the case with the gentleman that attempted to shave himself, whose symptoms I have already described *. When I first saw him, his pulse was scarcely perceptible. I took a little blood from the arm, and he was immediately seized with convulsions, like an epileptic fit, which I thought would have proved fatal. I closed the wound, and I would not upon any account have taken six ounces of blood from him at that moment. Some time ago I saw a man, at the other hospital, who had received a blow on the head. He was pale and dejected, and his pulse could scarcely be felt. I said to the dresser, " You must not bleed this man at present; there is

* See page 536.

rather too little action than too much; wait till the pulse rises, and then bleed him." In the evening re-action took place; the pulse rose, and the dresser then very properly bled him. Inflammation was by this means prevented, and the man did well. The principle upon which you should act, is never to do any thing in your profession without a good reason; which, whatever may be the result of the case, will leave your conscience clear. A surgeon who bleeds without being able to assign any other reason than that his patient has received a blow, is not fit to practise his profession.

Emetics. I have seen emetics of considerable use; the vomiting produced by them does good. I have always considered the efforts of nature to relieve herself after injuries salutary; and therefore the vomiting which is excited in cases of concussion, acts beneficially by relieving the stomach of its contents, as the accident generally happens to persons in a state of intoxication; it is also useful in propelling the blood to the brain, and thus restoring the powers of life. But the vomiting excited by nature restores the patient to his senses only for a short time. He is sometimes relieved, but without continuing so long; he looks about, and lapses into his former state of aberration of mind, from which he had received merely a temporary relief. When emetics are exhibited as a remedy in concussion, there is only one thing that I fear from their use; where there is any extravasation

of blood in the brain, or any tendency to apoplexy, then they should be employed with caution; and on that account, I generally wait for three or four hours after the accident before I order them.

Cathartics. With respect to the exhibition of cathartics, the bowels should be kept open by calomel purges, followed by the infusion of senna and sulphate of magnesia. The calomel should be given about two hours after the accident; and it will be useful to give to the patient at the same time a quantity of mild fluids to drink, as by this means a disposition to purging is kept up; counter-irritation is, as it were, produced, and the blood is drawn from the brain to the intestinal canal.

Diaphoretics. Perspiration on the surface of the body is very desirable, and for this purpose antimonials are employed. The pulvis Ipecacuanhæ Composita (Dover's powder) is not generally used to produce moisture of the skin, on account of the opium it contains; which confounds the judgment, and prevents you from seeing what are the effects of the opium, and what those of the disease: for opium produces the same disturbance to the brain as takes place in concussion, and therefore is not often employed.

Counter-irritation. Counter-irritation is of use, but not until other means have been resorted to; the object of blisters is to subdue the inflammation when other means have failed. I have known a patient, with pain in the head, sickness at the stomach, loss of

strength, and throbbing of the carotids, who had only derived temporary relief from blood-letting, to have been greatly benefited by the application of a blister; on the principle not of increasing but subduing action, from an excess of which ill consequences are to be feared.

Trephining. For the symptoms arising from concussion, the trephine used to be employed; but now, it becomes a question whether this operation ought ever to be resorted to as a means of relief under such circumstances? To this I say, that he who employs the trephine, ought, in turn, to be trephined himself. What will trephining do? Probably great harm, by disturbing the brain; and if not, no good can possibly result from it.

The evils of trephining. Now for the proofs:—first, that it does no good. I was very intimate with Mr. T. of Yarmouth, where I used to spend a good deal of time when a boy. After my apprenticeship was finished, I went down to this place, and found him labouring under the effects of concussion; he had received a blow on the forehead from a bludgeon, and was afterwards frequently seized with sickness at the stomach; his mind was not in the least affected. I called on him, and, on going into the room, said, “I have come to ask you how you are;” in approaching me he was obliged to put his handkerchief to his mouth to prevent the contents of his stomach going over me. In his walks he had frequent vomitings. A re-

lation, who was at Yarmouth twelve months after this, said to him, that he had better have the trephine applied, and the portion of bone removed : to which he readily consented. His symptoms were not relieved by the operation ; he soon got worse and worse ; his bowels became costive, the powers of the mind were affected, and he died in consequence of the operation, though he had lived two years after the injury, before it was performed. Mr. B., now in Yarmouth, was living with him at the time, and could tell more of the particulars than myself ; but this I know, that he was not benefited by the operation, but injured by it.

But a more direct proof that it is dangerous is mentioned by Dr. Farre. He knew a person, the subject of epileptic fits resulting from concussion of the brain, who was extremely anxious to be trephined. The operation of trephining was performed, and he died soon afterwards.

I do not mention these as uncommon cases ; but this used to be the plan adopted with almost all the patients admitted into these hospitals during my apprenticeship. They were all submitted to the operation ; inflammation of the membranes of the brain supervened, and nearly all died ; recovery being very rare. But do our patients now die from the effects of concussion ? No ; by bleeding and general depletion we rarely lose a patient : perhaps, we have fallen into the opposite extreme. After the expiration of my appren-

ticeship at these hospitals, I went over to Paris to see the practice of Désault, at the Hôtel-Dieu; and there I found that never, under any circumstance whatever, did he trephine; and that he was more successful than those who were constantly doing it here.

Trephining abandoned. Trephining in concussion is now so completely abandoned, that, in the last four years*, I do not recollect performing it once: whilst thirty-five years ago I should have performed it five or six times a-year.

Keep the mind quiet. Pay strict attention to the mind. Excessive anxiety must be prevented; for if the mind be disturbed, little or nothing is effected towards the recovery. I was very much struck with an instance of this, which occurred about twelve months ago. A boy was brought to me, from the north of England, who had lost a portion of the skull just above the eye-brow; and I was asked (for it was for this purpose that I was consulted) what protection should be given to the denuded brain? On examining the brain, I distinctly perceived the pulsation was regular and slow; but, while examining him, he became agitated by some means or other; directly, the blood was sent with increased force to the brain, and the pulsation became more violent. Therefore, do not omit to keep the mind free from agitation, otherwise the treatment will be unavailing.

* Prior to the year 1824.

Treatment of
concussion in chil-
dren. Lastly, the treatment of children. As the surgeon cannot always bleed them from the arm, he must give the chloridum hydrargyri (calomel) with mild drink, so as to purge them; leeches must be applied to the temples; the jugular vein must be opened.

After-treatment. For the symptoms after concussion, such as pain in the head or sickness at the stomach, make an incision through the scalp and insert issues; wash the head with spirits of wine and water, which is better than any thing else I know; and use the shower-bath two or three times. These are the best means for giving power to the nervous system, and bringing the action of the brain into a healthy state.

SECTION III.

.COMPRESSION OF THE BRAIN.

We have now to consider the symptoms, causes, and treatment of compression.

Symptoms. When a person is labouring under compression of the brain, it is known by the breathing being stertorous, the pulse slow, and the pupils dilated; to which may be added the symptoms of concussion. When, then, a patient has the apoplectic stertor, slow pulse, and dilated pupils, it will generally happen that the brain is compressed.

Causes. The causes which produce compression are three :—1. Extravasation of blood ; 2. Fracture with depression ; 3. Formation of matter within the skull. These are the three causes which give rise to compression : we shall first consider compression when produced by extravasation.

Compression from extravasa- When the brain is compressed by extravasated blood, the symptoms do not occur immediately ; the person, at the time of the injury, is often stunned, recovers himself, after a short time falls into a comatose state, and then the apoplectic stertor begins. The following case will illustrate this.

Case. A child was playing on a table, from which it fell on a stone floor, and received a severe blow on the head, which caused compression of the brain. The child appeared to recover at four in the afternoon, the time at which the accident occurred being one ; pain in the head still continued ; the child cried considerably ; it went to bed about two hours before its usual time ; during the night, the servant was awoke by the apoplectic stertor of the child, which prevented her from sleeping ; when she moved it, the child was not roused ; she discovered that it was ill, alarmed the family, and at eight in the morning it died.. It was found after death, that a considerable quantity of blood had been extravasated in the brain.

Case. The son of a most respectable mer-

chant in the city was driving to his country house, at a short distance from town, in a one-horse chaise; when he was thrown out, and pitched with his head on the ground. He was stunned by the fall; he recovered a little, but looked very pale, and said that he was much hurt. A friend who was with him drove him home. In the evening, he felt very heavy, laying his head on his hand, and symptoms of compression of the brain came on. At ten o'clock, p. m., the family were alarmed, and medical assistance was called; but he died at two the following morning, all efforts to save him being unavailing.

Extravasation
with concussion.

Extravasation with concussion renders the case of a different nature; then the symptoms of concussion, such as I have already described, come on first, and the apoplectic stertors and other symptoms of compression succeed.

Case. A gentleman was at a party with some friends. He drank freely of wine, and became intemperate. His home was some distance from the place at which he was spending the evening; and his friends seeing that he would be exposed to great risk, wished him to stop, but he could not be prevailed on. He mounted his horse, and, on the way, he was thrown off. He returned home; fell into a comatose state; symptoms of concussion with loss of voluntary motion first came on, unattended by any appearance of extravasation. At two the following morning, apoplectic stertor came on, and

at eleven he died. In this case, symptoms of concussion came on first, and those of compression afterwards. Blood was found extravasated in the brain, as might be expected.

Situation of
the extravasated
blood. Extravasated blood, when it produces compression of the brain, is generally situated in three different parts :—between the dura mater and pia mater ;—between the pia mater and brain ;—or within the substance of the brain itself. The most extensive effusion beneath the dura mater, which I ever saw, amounted to three ounces. Effusion between the pia mater and brain is of more common occurrence ; and, in this case, a large portion of the brain will often be found covered over with blood ; not that the quantity of blood extravasated is considerable, but a little is diffused over a large space. In the case of a man who fell from the yard-arm of a ship, and died four hours after his admission into the other hospital, (Guy's,) on examination, after death, the vessels going from the pia mater to the brain were found to be completely torn through. Effusion sometimes occurs within the substance of the brain itself. I have a preparation that was taken from a person in the city, who had extravasation within the brain from an accident. He considerably recovered after the injury, though pain still continued in the head; in three months afterwards he died, and on examination there was found, in the anterior lobe of the cerebrum, a coagu-

lum of blood, no portion of which had been absorbed, as the surfaces close to the brain were quite smooth.

These are the three situations in which extravasated blood is principally found. I do not find any difference of symptoms produced by the different situations of the blood ; the compression is produced by the pressure of the blood, and the quantity of blood effused will depend on the size of the vessel of the dura mater that is divided : whatever is the situation then of the blood, the symptoms of compression are the same. If there should be any blood resting on the origin of a nerve, there will be partial paralysis of the part which that nerve supplies.

Treatment. In the treatment of these cases there is little to be done. If extravasation of blood occurs with fracture, trephining may be of use. Depletion should be freely used, for the purpose of preventing inflammation. Irritation is to be lessened, the bowels are to be opened, and the patient kept very quiet. If there is a bruise near the fracture, indicating the spot where the effused blood is, the trephine may be employed before symptoms of excitement come on. When they take place, the surgeon must deplete only, and not dream of performing the operation ; to do it under such circumstances would be highly absurd, and the height of madness.

SECTION IV.

FRACTURES OF THE SKULL.

a. Fracture without depression.

Not dangerous. Fractures of the skull are not of themselves dangerous, nor are they injurious to the brain; and therefore do not call for any alarm, if care be taken to prevent inflammation. The danger, in these cases, most to be apprehended, arises from disturbance in some distant part, irritation of the system, or extravasation; and not from the fracture itself. Therefore, when called to a case of fracture of the skull, do not operate, but consider the symptoms that are present, endeavour to ascertain from what they arise, and then regulate the treatment accordingly. If the symptoms are those of concussion, the treatment must be directed to it; if those of extravasation of blood, and there is not much excitement, it will be necessary to remove a portion of bone; but if there be fracture only, without any of the symptoms above mentioned, there will be no occasion to operate.

Fracture at the base. When a fracture occurs at the base of the skull, it is much more dangerous than at any other part, because extravasation is much more likely to take place; or, if not, inflammation of the brain, from the violence of the injury received, very often supervenes. The mode in which these fractures are produced, is by falling from a great height

.on the summit of the head, when all the weight of the body rests on the foramen magnum, and cuneiform process of the os occipitis. Great injury is, in this way, produced ; in very many cases a transverse fracture through the foramen magnum, cuneiform process, and part of the temporal bone is the consequence ; a discharge of blood into each meatus auditorius takes place, and where there is no other mischief, deafness often remains for life.

Fracture within the orbit. A curious fracture within the orbit sometimes occurs, as in the following case, where destruction of life was the consequence of the injury received. A child was playing with a scissors, when the point of it entered the upper part of the orbit, between the ball of the eye and the superior eye-lid ; from which the scissors were with difficulty extracted. The child's eye did not become inflamed. After the accident the child walked from Walworth to Mr. W., of Hatton Garden, who attended it. On the 10th day from the time of the mischief, symptoms of compression of the brain came on ; rigors, and inflammation of the brain supervened, and the child died. On examining the body after death, it was found that the scissors had penetrated through the orbital process of the os frontis, and lacerated the dura mater ; a considerable quantity of extravasated blood was found ; and the anterior lobe of the cerebrum was punctured by the point of the scissors, from which it had received the injury.

Circular fracture of the cranium.

It now and then happens that a blow received upon the summit of the head will produce a circular fracture of the entire cranium, commencing at the top of the head, passing down on each side through the temporal bone, and meeting at the basis.—Mr. Chandler, late surgeon of Guy's hospital, had a case of this description. There did not appear to be any extravasation or concussion; great irritation and violent inflammation succeeded, which destroyed the patient. After death, it was discovered that there existed a complete circular fracture of the skull, and that the anterior portion could be freely separated from the posterior: I believe these cases always terminate fatally.

Fracture over the frontal sinuses.

There is a curious fracture of the skull which occasionally occurs over the frontal sinuses. When the fracture is simple, if the nose be blown, the air escapes through the opening in the bone, and getting into the cellular membrane under the skin, renders the forehead emphysematous. If, on the other hand, the fracture is compound, upon blowing the nose, the air rushes through the wound; so that, in either case, the nature of the accident may easily be ascertained.

Unite readily.

Fractures of the skull, if unaccompanied with concussion or compression, as readily unite as fractures of the bones in any part of the body. A curious case occurred where a circular, or rather oblong, piece of bone was completely sepa-

rated from the parietal bone by the cut of a sabre ; and yet it became re-united. Fractures of the cranium, therefore, easily unite. Where, however, large holes are made through the skull, the apertures do not again become filled by ossific matter, but by a tendinous structure formed from the bone and dura mater. The holes made in trephining are supplied in this manner, and not by bone. In fracture of the skull, where the bones are separated to some distance, also, the interspace will not become filled by bony matter.

Treatment. When there is simple fracture, unaccompanied by symptoms of injured brain, the surgeon must not trephine ; neither is it admissible in compound fracture. But he must, by the application of adhesive plaster, endeavour to heal the wound in the scalp as quickly as possible. The constitutional treatment should consist of depletion, by means of blood-letting and purgatives. This plan often removes symptoms of concussion, and even extravasation, which accompany these fractures ; and frequently a few hours will show that the application of the trephine, which at first might have been thought indispensable, is wholly unnecessary. It is wrong, therefore, to be too much in a hurry in these accidents ; for irreparable mischief might arise from converting a fracture, which was simple, into one that is compound. Wait then for awhile, before proceeding to operate in such cases, for the purpose of seeing what

effects may be produced by bleeding and purgatives. It not unfrequently happens in these hospitals, upon persons being brought in who have received injuries of the head, that the dresser in attendance will bleed them immediately after their admission, and at the same time send off for the surgeon; before whose arrival, however, the good effects of the loss of blood are apparent, and the symptoms of concussion, and even of extravasation, have often disappeared. This shows how necessary it is not to be too precipitate. Therefore, he will act most prudently, who will try bleeding and purgatives before proceeding to operate; for whether he does so or not, the depletion will prove of the greatest possible advantage in preventing inflammation, from which arises the principal danger, if not kept within bounds.

b. Fracture of the Skull with depression.

Symptoms come
on immediately.

In order to ascertain whether the symptoms arising from depression would come on immediately after the accident, I tried the following experiment.—A gentleman having brought me a large dog, I applied the trephine to his cranium, and took out a portion of the bone. I then, with the handle of a knife, separated the dura mater from the bone, (for I found that I could make no impression on the brain until I had done so,) and pressed upon it with my finger. At first the animal did not seem to

feel it; but upon pressing more deeply, it produced pain and irritation, and he endeavoured to avoid me. Upon still increasing the pressure, he became comatose, and fell. I kept him in that state for five or six minutes, when, upon removing my finger, he got up, turned round two or three times from giddiness, and walked away, apparently little worse for the operation. A gentleman who felt the animal's pulse during the continuance of the experiment, stated, that it became slower as the pressure became increased. In man it is the same—slow and labouring.

Apparent depression. After blows have been received on the head, it often happens that upon making an examination of the scalp, there appears to be depression of bone to a great extent, when, in reality, there is none. This must be guarded against. A person receives a blow on the scalp: the parts immediately surrounding the spot where the blow was received will rise, from the extravasation of blood, two or three lines higher than the part itself; for there, the cellular membrane having been condensed by the injury, will likewise tend to increase the deception: thus the surrounding parts are considerably higher than the middle; and the external character of the contusion is certainly calculated to deceive those who are unacquainted with the nature of these accidents.

Case. I have several times seen these affections; but the first case which I recollect was that of a child brought into Guy's, who had received a severe

blow on the head from a brickbat, which had been thrown at it by a man. All present were prepared for the operation, fully expecting that I should apply the trephine; for they felt convinced that there was considerable depression of bone; and, when I stated that I should not operate, they exclaimed, "Good God! I wonder what can be his reason." This child, after having been freely bled and purged, in two or three days quite recovered.

I have often been sent for by my dressers to these cases, and have been requested to bring my instruments with me; but upon examination have found that there was no depression of bone, and that the uneven appearance of the scalp was produced by the causes before mentioned.

Depression of the external table. It also very often happens in fractures of the cranium that considerable depression of bone will take place from the external table of the skull being driven into the diploe, without producing the slightest injury to the internal table. These fractures, however, can only occur in persons of a middle age, for, in early youth and extreme old age, the skull is thin and without diploe. Do not, therefore, be precipitate in the diagnosis, nor hastily determine upon performing an operation, which you might afterwards have reason to repent. I believe, in the course of my practice, that I have frequently met with this accident; there are, also, many preparations in the museum of St. Thomas's Hospital which clearly demonstrate its true

character, and are, I think, quite sufficient to satisfy any one as to the nature of this accident. I am not acquainted with the histories of these specimens, but, that the persons recovered, is evident from the reunion that has occurred between the parts which were broken.

Treatment of simple fracture of the skull. When a surgeon is called to a patient who has had a severe blow on the head, and, on examining the skull, discovers that a portion of the bone is considerably depressed ; he may still find the patient capable of giving a history of the accident, and not at all affected in intellect. On the other hand, he may be called to a person who has fracture of the skull with depression, and who has lost the powers of mind. In this case, if the fracture be simple, unattended by wound in the scalp, or symptoms of injury to the brain, it would be the worst possible practice to make an incision into the part, and perform the operation of trephining ; for, by making such an incision, the surgeon converts a simple into a compound fracture, which greatly increases the danger of inflammation, and consequently the danger of the patient. Inflammation rarely follows fracture with depression, where the fracture is simple, but very often follows a compound fracture, which is produced by making an incision in the scalp. Never make an incision, therefore, when it can be avoided, or merely because there is fracture with depression, unless there be symptoms of injury to the brain. Even if there

be symptoms of injury to the brain, and the fracture be simple, do not immediately trephine. Take away blood, purge the patient freely, and see how far the symptoms may be the result of concussion of the brain, and not of depression. If the symptoms do not yield to depletion, then, and not till then, perform the operation of trephining. I was called to a lady who had fallen against a projection of a wall in walking across her parlour. The os frontis was driven in, but there were no symptoms of compression of the brain. I bled her, and guarded cautiously against inflammation, but there was no necessity for elevating a portion of the bone. This lady never had any symptoms of injury to the brain, and she recovered by depletion alone.

Old practice. According to the old practice, as soon as injury to the brain was suspected, and the least depression of the bone appeared, the surgeon made an incision into the scalp. I have heard of a dresser in these hospitals*, who, having had no accident during his week, said, "I will make a cut in the head of one of my patients with fracture, for he may perhaps have depression, and I shall in this way have something to do before my week is up." This dresser ought to have had a cut made in his own head ; because he was putting his patient to considerable hazard, by converting a simple into a compound fracture. In simple fracture, then, when it is attended with symp-

* Guy's and St. Thomas's.

toms of injury to the brain, deplete before you trephine; and when it is unattended with such symptoms, though there may be depression, deplete merely, and never divide the scalp.

Treatment of compound fracture If the fracture be compound, the treatment must be very different; because a compound fracture is followed very generally by inflammation of the brain, and it will be of little use to trephine, when inflammation has once appeared. It might be thought time enough to perform the operation when inflammation had appeared; but this is not the case, for if inflammation comes on, the patient will die whether the trephine be employed or not, and so far from arresting its fatal progress, that operation will only add to the danger of the inflammation. When inflammation of the dura mater and membranes of the brain has been excited by the depression of the bone, it is impossible to retard the progress towards death by performing the operation.

Illustrative cases These principles may be illustrated by many cases. During the first year of my apprenticeship in these hospitals*, I saw two instances; one, in a patient of Mr. Cline's, and another in a patient of Mr. Birch's. Mr. Cline's patient was a man who came from Walworth, with compound fracture, from a blow on the head. A portion of bone had been forced into the cavity of the skull. Mr. Cline advised him to submit to the operation of trephining. The

* St. Thomas's and Guy's.

man said, " You may do what you like; I am no judge, but you are, so do what you please with me." Accordingly, he walked into the operating theatre to be trephined; the portion of bone was removed; he walked back again to bed, and never had a bad symptom. A short time after, a patient under Mr. Birch, with fracture and depression, was told that he was in similar danger, and advised to undergo the same operation. He, however, was self-willed, and obstinately refused to submit to it. Eleven days after the accident, he was seized with pain in the head, and symptoms of inflammation in the brain appeared, and when he became insensible, the operation of trephining was performed; but it did not arrest the symptoms, and he died of the inflammation. In the other hospital* two boys were admitted under very similar circumstances. The os frontis had, in one case, been broken by a kick from a horse, and in the other by a fall on the forehead. In the former case the portion of bone was raised, and the boy did well; but the mother of the other boy interfered to prevent the operation of trephining; and though it was performed after symptoms of inflammation had appeared, he died.

Use of the elevator. It often happens that fracture with depression is not followed by inflammation, even when the fracture is compound; but we cannot be certain of this, and if it does ensue, we

* Guy's.

cannot save the patient by trephining at a late period. The rule, therefore, which I always follow, is this:— When called to a case of fracture with depression which is exposed to view, I generally use an elevator, and very rarely the trephine. I put this instrument under the depressed portion of bone, raise it up, and if it has been comminuted, remove the smaller portions. If, however, one portion of bone is wedged within the other, I then apply the trephine for raising the depressed portion. The elevation of the bone is never followed by any mischief; but if the surgeon does not raise it, and inflammation follows, it will be too late to attempt to save the life of the patient. I shall conclude my remarks on this subject by mentioning two other circumstances, to which I desire most particularly to call the attention of the reader.

Spiculae projecting from the inner table.

The first is this. It sometimes happens, in fracture of the skull attended with depression, that a small spicular portion of bone will project into the brain, so as to produce epileptic symptoms. A negro, who was a patient of Mr. Birch, had fracture from a blow on the head, and a portion of bone was depressed. Shortly after the accident, he was seized with epileptic fits, which continued for many years. When he was admitted into the hospital, it was found that a portion of bone was still depressed, and the trephine was applied to it. When the circular piece of bone was completely sawed round by the trephine, so that it could

be moved from side to side, Mr. Birch found a difficulty in raising it; he put the elevator under it, but still it adhered to something within. At last he took a pair of forceps, and, by using more force, he extracted a little spur or thorn, which had proceeded from the inner side of the skull through the dura mater into the substance of the brain, and was the cause of the epileptic fits. After its removal, the patient had but one more fit, and completely recovered.

Case of suspend-
ed sensation and
volition for thun-
teen months.

The other circumstance that I shall mention, is one which, whether we regard it in a physiological or surgical point of view, is, perhaps, one of the most extraordinary cases that ever occurred; and, as connected with surgery and physiology, I am surprised it has not made a greater impression on the public mind than it appears to have done. A man was pressed on board one of his Majesty's ships, early in the late revolutionary war. While on board this vessel, in the Mediterranean, he fell from the yard-arm, and, when picked up, was found to be insensible. The vessel soon after making Gibraltar, he was deposited in an hospital in that place, where he remained for some months, still insensible; and, some time after, he was brought from Gibraltar on board the Dolphin frigate, to a dépôt for sailors at Deptford. While he was at Deptford, the surgeon, under whose care he was, was visited by Mr. Davy, then an apprentice at this hospital: the surgeon said to Mr. Davy, "I have

a case which I think you would like to see. It is a man who has been insensible for many months; he lies on his back with very few signs of life; he breathes, indeed, has a pulse, and some motion in his fingers, but in all other respects is apparently deprived of all powers of mind, volition, or sensation." Mr. Davy went to see the case, and, on examining the patient, found a slight depression on one part of the head. Being informed of the accident which had occasioned this depression, he recommended the man to be sent to St. Thomas's Hospital; where he was placed under the care of Mr. Cline. When first admitted into the hospital, I saw him lying on his back, and breathing without any great difficulty; his pulse regular, his arms extended, and his fingers moving to and fro corresponding to the motion of his heart: so that you could count his pulse by this motion of his fingers. If he wanted food, he had the power of moving his lips and tongue; and this action of his mouth was the signal to his attendants for supplying his wants.

Mr. Cline, on examining his head, found an obvious depression; and thirteen months and a few days after the accident, he was carried into the operating theatre, for the purpose of being trephined. The depressed portion of bone was elevated from the brain. The motion of his fingers continued during the operation, but no sooner was the portion of bone raised than it ceased. The operation was

performed at one o'clock in the afternoon; and at four o'clock, as I was walking through the wards, I went up to the man's bed-side, and was surprised to see him sitting up in his bed. He had raised himself on his pillow. I asked him if he felt any pain, and he immediately put his hand to his head. This showed that volition and sensation were returning. In four days from that time the man was able to get out of bed, and began to converse; and in a few days more he was able to tell us where he came from. He recollects the circumstance of his having been pressed, and carried down to Plymouth or Falmouth; but from that moment up to the time when the operation was performed, (a period of thirteen months and some days,) his mind had remained in a state of perfect oblivion. He had drunk, as it were, the cup of Lethe; he had suffered a complete death, as far as regarded his mental and almost all his bodily powers; but, by removing a small portion of the bone with the saw, he was at once restored to all the functions of his mind, and almost all the powers of his body.

It appears, therefore, that in cases of depression we should not be prevented from trephining, however distant the period may be at which the accident occurred; and the patient may, after any interval, be restored to the powers of body and mind.

SECTION V.

WOUNDS OF THE BRAIN, AND THEIR
CONSEQUENCES.

Symptoms. Wounds of the brain will often happen, without producing any interruption to the operations of either body or mind. But should the wound be accompanied by either compression or concussion, then the particular symptoms which characterise those injuries will be present. If, however, the wound be a simple incision or laceration, it will often prove quite harmless. Indeed, it frequently occurs that considerable portions of the brain are lost, and yet the mental and bodily functions continue unimpaired. Epileptic fits and hemiplegia certainly sometimes follow, as effects of such injuries ; but, on the other hand, brain to a great extent has been lost without having been succeeded by disturbance of either the mental or bodily functions ; numerous cases of this description are upon record ; several have fallen under my own observation. A case similar to the following likewise came under the notice of a surgeon at Brighton.

Case. A dresser of the late Mr. Chandler once came to me when I was in the other hospital*, and said, "Look here, Sir," at the same time showing me a portion of brain, with a piece of the pia mater attached to it. I went to see this man, and found the

* Guy's.

representation of the dresser correct ; there was a large tranverse opening in the os frontis, through which a considerable quantity of brain had been lost. His mind was not at all affected ; neither were the bodily powers in the least disturbed ; no bad symptoms of any kind followed the injury ; the wound healed most favourably, and he was soon discharged. About a year afterwards, while I was at the house of a lady in the city, whom I was attending, a man walked into the room, and said to me, " How do you do ?" Not recollecting him, I looked at him with some sort of surprise, when he informed me that he was the man whom I had seen about a year before in St. Thomas's Hospital, with a wound in the head, and through which he had lost some of his brain. I replied that I could readily believe him. He stated that he had been quite well ever since,—he had what he called an opening where he received the wound ; was not subject to fits ; and to show that his mind had not sustained any damage from the accident, he was, at the time I saw him, conductor of an extensive business at the house where he was then living.

A portion of bone driven into the brain. It occasionally happens, when a portion of brain has been lost, that a piece of the cranium will, by being driven in, occupy its place ; and if in these cases no symptoms of compression manifest themselves, the depressed bone should not be elevated : for were this to be done, it would, in all probability, give rise to extravasation, or increase the

hazard of inflammation. The late Mr. Chandler had a patient in this hospital, who, on receiving a blow from a boat-hook upon the parietal bone, had a portion of that bone driven into the brain, and, at the same time, lost a quantity of the brain. At first there was hemiplegia; this effect, however, soon disappeared. The depressed bone was permitted to remain, and the individual perfectly recovered. Such cases are not uncommon, and I could relate a number of them.

Indications for treatment. The danger attendant on injuries of the brain arises principally from two causes: viz., inflammation, and the formation of fungus. But I am happy to say, that both of these may be conquered by scientific and prompt treatment. When the brain receives a wound, we must commence our curative exertions by abstracting as large a quantity of blood from the system as the constitution of our patient will bear; not, however, to such an extent as to prevent the restorative operations of nature. Do not lower the system to such a degree as to prevent inflammation altogether, as was done by the dresser in the other hospital, whose partiality for bleeding I have already mentioned*.

Fungous granulations. Though we succeed in keeping down inflammation, fungus will spring up. Sometimes wounds of the brain extend even to the ventricles, and lay open one of the lateral ventricles. Some days after the brain has been wounded, the divided

* See case described at page 541.

parts begin to unite by means of the adhesive inflammation ; if this process cannot effect a cure, granulations form, which at length project through the opening in the skull, and give rise to the fungus before mentioned. Upon proper treatment the safety of our patient depends. If we do not repress the growth of the fungus, there will be violent constitutional irritation, and the life of the person is in jeopardy ; but, on the contrary, if we attend to the condition of the wound, and prevent the fungus from rising, there will be, comparatively speaking, but little danger..

Treatment of the fungus. The treatment is as follows. Apply to the fungus a piece of lint, wetted with liquor calcis, and, over this, strapping of adhesive plaster ; when the part is examined on the following day, the fungus will be found considerably diminished ; then use a thicker piece of lint, and the strapping as before ; by pursuing this plan, we at length get the fungus to the level of the scalp. But this is not sufficiently low, therefore we must still increase the thickness of the lint until we have succeeded in getting it even with the edges of the dura mater, in which position it must be cautiously preserved ; when, at last, the dura mater heals over it, and the object is accomplished. We witness many examples of such cases in these hospitals.

Former treatment of fungus. Formerly it was the practice in these cases to remove the bone contiguous to the fungus : immense quantities of bone, in this manner,

were taken away, thereby affording every facility to the growth of the fungus, and which, of course, rapidly increased, until the patient was destroyed. By such treatment as this, no person could possibly recover : the method was a most injurious and stupid one : therefore let me caution my readers against adopting it. The plan of treatment which I have just recommended is unquestionably the best : viz., that of repressing the growth of the fungus until the dura mater heals over it.

Inflammation following wounds of the brain. I shall now treat more particularly of inflammation following wounds of the brain, wherein their chief danger consists ; and which danger is much increased if the dura mater be the part attacked. Upon the first approach of inflammation, the person complains of a great pain in the head ; very quickly falls into a comatose state ; and, when roused from this condition, the pain is excessive ; the scalp, round the external wound, becomes œdematosus, and, if pressed upon, retains the impression of the finger ; the edges of the wound have a shining glossy appearance, and a fluid is discharged which is composed of blood and serum ; sometimes the parts about the wound have a sloughy appearance ; the countenance is very much flushed ; and the carotid arteries beat with so much force, that, if the shirt collar be open, the surgeon may see their pulsation some distance from the bed,—a circumstance quite sufficient, of itself, to indicate a great determination

of blood to the brain. The next thing to be observed is, that the patient is seized with rigors, which follow in very quick succession ; hemiplegia also frequently comes on, and is generally situated on that side of the body opposite to the wound ; the patient remains in a comatose state, but, when roused, will give (until towards the very last) rational answers to such questions as may be put to him. These, then, are the ordinary symptoms of inflammation of the brain, arising from wounds of that organ.

Suppuration. If the inflammation should terminate in suppuration, I have already shown where the matter would be situated ; viz., between the dura mater and skull, (this rarely happens,) pia mater and tunica arachnoides, pia mater and surface of the brain, and lastly, in the substance of the brain itself.

Pus between the skull and dura mater. When pus is situated between the dura mater and skull, trephining for its removal would be attended with complete success ; but the chances against finding it there are very great, as it is generally situated between the pia mater and surface of the brain, for which an operation would prove worse than useless. Another situation in the head where matter has been found, is in the longitudinal sinus of the dura mater. I remember the case of a woman, who, seventeen months before she died, fell down stairs, and her head came in violent contact with a chest, by which she became stunned ; for some time after the fall, matter was discharged from one of

her ears ; this at length ceased, and, to all appearance, she was entirely well. The pain, however, again returned with evident symptoms of compression ; and sixteen months after the accident she was admitted into this hospital *. After some remedies had been fruitlessly tried, and she had been here for a short time, it was thought advisable to apply the trephine ; the operation was unsuccessful, and four days afterwards she died. Upon examination, a small quantity of pus was found embedded in the longitudinal sinus. This is the only example of the kind which I have witnessed.

Pus between the arachnoid and pia mater The next part in which matter is situated is between the tunica arachnoides and pia mater, or between the pia mater and brain itself. This last is of most common occurrence, and in this case the matter is diffused over the hemispheres of the brain, in the same manner that blood is, when extravasated on that organ. When the matter is situated between the pia mater and brain, it will be of no use to operate, as very little will be discharged ; for the matter is contained in distinct cells, between the vessels which come from the pia mater to the brain, which do not communicate with each other.

Pus in the substance of the brain. The next situation in which matter may be found, is in the substance of the brain itself. I have several specimens showing that matter may

* St. Thomas's.

be lodged in various parts. One very curious circumstance in this complaint is, that no one would suspect the formation of matter from the symptoms; they being those of compression rather than irritation. If the membranes of the brain be attacked with violent inflammation, symptoms of irritation will be present; but if the brain itself be attacked, the symptoms will rather indicate compression; and a person, who examines the brain of an individual in which matter has been formed, is surprised to find that so little constitutional irritation has existed during its formation. It is in inflammation of the membranes, and not of the brain itself, where the greatest irritation is present. I have a curious specimen which was taken from a child that I had under my care, and on whom I performed the operation of trephining; the history of the case was as follows:—

Case. A young child was playing in a yard where there were some fowls, when it received a wound on the head from the beak of a cock. The mother hearing the child shriek, ran to the spot, and found a small wound of the scalp, but thinking that no injury had been done to the brain, she bound it up. In a week afterwards, pain in the head came on, together with great constitutional irritation, and the child was brought to me. On examining the head, I found that a circular incision had been made in the bone, and that matter issued through the opening. I said to the mother, if the child is not

better by to-morrow, bring it to me again, and I will allow a more free opening for the matter to discharge itself. The next day the child was brought to my house; I performed the operation of trephining, and discovered an opening in the dura mater and pia mater, corresponding to that of the bone. The symptoms of irritation were relieved by the operation; those of compression however came on, and, in three days from the time in which it was performed, the child died. On examining the part after death, I found a circular incision in the dura mater, the edges of which were hardened and thickened; a similar aperture existed in the pia mater and brain, corresponding in size to the external opening, and an abscess was found between the pia mater and brain. At that time I had no idea that a wound, of the description I have just mentioned, could be produced by a bird of this size; but since that period, I have seen an instance of a similar kind: a pheasant, not an English, but an Indian one, made a dart towards the eye of a person, and, instead of striking it, wounded the os malæ; the bird, by means of its beak, struck a hole into the superior maxillary bone, just below the zygomatic arch.

Period when inflammation supervenes. The time at which inflammation of the brain supervenes after the receipt of the injury, is generally about a week; rarely under that time: it often happens that inflammation of the brain does not come on till a fortnight, or even three weeks,

the injury : therefore every surgeon, who has written on the subject, puts us on our guard as to the distance of time that inflammation may come on after the accident, and says that the patient is not safe till two or three weeks afterwards. It is mentioned in the works of Mr. Pott on injuries of the head ; and in the work of Mr. Dease*, of Dublin, (who has published an excellent treatise on the subject,) it is distinctly stated, that inflammation of the brain is occasionally postponed to three or four weeks after the accident occurs, and even then, the patient is not always safe. Inflammation of the brain, therefore, is more slow in its occurrence than that of any other organ.

Cases. I will mention a case relating to this subject :—Dr. Babington and myself were sent for to see a person, a clerk to the firm of Whitbread and Co., who, whilst riding on horseback, being a short-sighted man, struck his head violently against the bough of a tree which overhung the road, and was brought to the ground by the force of the blow. He was taken to Croydon, where Dr. Babington and myself visited him. We found that he had been struck on the os frontis, and there was a depression just above the frontal sinuses. This was the first case in which I witnessed emphysema of the forehead produced by blowing the nose. We took all possible

* Observations on Wounds of the Head. 8vo. London, 1776.

care of the case, bled him, regulated his diet, and so forth, till the inflammation had subsided. He came to town three weeks after the accident, and asked whether he might go to Rochester, to spend a little time with some friends, who were anxious for him to come. We told him that he might, if he would pay attention to himself, keep his bowels open, and regulate his diet. After the lapse of a week he became extremely ill, inflammation of the brain came on, and he died. On inquiry, we found that he had neglected the directions given him, and allowed his bowels to become constipated. It is always very serious when there is a depression on the forehead after an accident. I will mention an instance, which will shew the necessity of enjoining, on a patient with this injury, strict attention to his mode of living. A man who had received a wound in the forehead from a pistol shot came to this hospital : the wound healed kindly, but the depression remained. Whenever this man indulged in the use of spirituous liquors, he used to come back with violent pain in the head, which was always relieved by blood-letting.

Treatment. As to the treatment of inflammation of the brain, it is the same as for inflammation generally, with this exception only, that blood should be drawn from the temporal artery in adults, and the jugular vein in children. Whenever inflammation of the brain attacks a grown person, take blood from the temporal artery; and when it attacks young indivi-

duals, from the jugular vein; by these means blood is abstracted more readily from the part. Even in adults we may, after opening the temporal artery, if the symptoms be not relieved, bleed from the jugular vein. In addition to this treatment, purge, excite the perspiration, and apply blisters to the head. I have seen poultices, containing some stimulating application, of considerable use.

SECTION VI.

THE OPERATION OF TREPHINING.

Cases in which it is required. It will now and then happen that trephining may be required; and the cases in which it will be necessary are;—1. Where there is extravasation of blood between the dura mater and skull. 2. In simple fractures, with depression and symptoms of compression continuing after depletion. 3. In compound fractures, with depression, unaccompanied by symptoms of compression. 4. When there is matter between the dura mater and skull.

It generally happens in these last cases, where there is matter between the dura mater and skull, that there is also fracture; and this, when it is followed by rigors, and other symptoms, is an indication that some injury has been done to the brain. Still it will be right, in some cases where there is no fracture, the rigors and other symptoms being pre-

sent, to penetrate the bone, and see whether matter is lodged between it and the dura mater ; and this is the only case in which it is proper.

The instruments to be employed. The operation of trephining used to be one of the most complicated kind, requiring several instruments, the learning of which was in itself quite a study ; it is now quite simple, and few instruments only are wanted, which can very easily be put into a small case. The instruments formerly used in this operation were so numerous that I do not know whether I can count them. They used a scalpel, rougee, pin, perforator, crown, brush, elevator, lenticular, and a pair of forceps ; now, three instruments will be quite sufficient,—a knife, with a double edge, in order to scrape off the pericranium, an elevator, and a trephine having a crown, and a pin which will allow of being easily moved.

Parts not to be trephined. I will now proceed to point out in what parts the trephine should not be applied. First,—never apply the trephine in the line that extends from just above the nose along the top of the head to the tuberosity of the occiput ; over the frontal sinuses it is obviously improper ; so also at the summit of the head over the sagittal suture, where the dura mater adheres with extraordinary firmness, and the longitudinal sinus is situated ; and at the posterior part there is the superior portion of the perpendicular spine of the os occipitis : therefore it is improper to trephine on any part of this line. I mention this more particularly

for the benefit of young persons, who very often disregard this rule, thinking they know much better than those who have preceded them: if, however, they trephine on this line, they incur an unnecessary risk, by cutting down on a long canal covered over by a smooth membrane, when they might, as easily, do it on either side. It would be the folly of presumption to trephine on this line. Secondly,—the operation of trephining should not be performed over the anterior inferior angle of the parietal bone, just above the zygoma; because the great artery of the dura mater is situated opposite to this point. Thirdly,—behind the ears, on the posterior inferior angle of the same bone, is equally improper for the application of the trephine, the great lateral sinus being opposite to the posterior inferior angle.

The elevator, and Hey's saw. Fractured portions of the cranium, at these parts, may be raised by the elevator: which, I may observe, is the instrument chiefly used in this class of cases. Mr. Hey's saw is a very useful invention.

Mode of performing the operation. It is gratifying to state that we are seldom called upon to perform this operation now. If, however, you are called to a case requiring it, where there is a wound, together with depression of the parietal bone, put your finger into the wound, and, if the portion of bone depressed be small, make a simple incision, and turn the integuments aside, so as to reach the bone. If, by this in-

cision, depression with fracture is detected, enlarge it in the course of the fracture: if the depression be large, make a crucial incision, and turn aside the portion of integument, so as to open a space for the application of the trephine; then, with the back edge of the knife, (which should be made a little stronger than usual,) cut through the pericranium, and scrape it off. For this purpose the rougee was formerly employed. Then apply the pin to the skull, and the crown being adjusted, fix it, and begin the circle. Having made a circle, remove the pin: in young persons it will be necessary to do this soon, because the bone is readily sawn through. I never, myself, saw a case in which the pin entered the brain; but my nephew was present when the operation of trephining was performed, and the *pin was forgotten*, so that it entered the brain, and inflammation of the dura mater came on. I can conceive that a man in his first operation, anxious how he shall succeed, might forget it. When using the saw, let your bearing on it be as even as possible, or else you will saw through one part of the skull before another.

Do not wound
the dura mater. There is but one danger in performing the operation of trephining, and that is, wounding the dura mater. When performing the operation of trephining on living subjects, the surgeon is informed of the progress he is making by blood issuing from the wound when he reaches the diploe: and when he sees the blood, he will know that he is half through:

but, it should be recollect that, in very young or old persons, there is no diploe; therefore, very few turns of the saw will do. As the operation proceeds, introduce a probe from time to time, to see how nearly it is through. When the bone is sawn through in one part, introduce the elevator, and lift the portion of bone; the parts not cut through being easily broken.

Danger of the operation. Some people say that this is a trifling operation, not difficult to perform, or dangerous in its consequences: but in this they are wrong. It is one of the most dangerous operations in surgery; whilst performing it there is but a single step, a small network between your patient and eternity; saw through this, and the destruction of life will generally be the consequence. Mr. Hunter made an assertion, that when the dura mater was wounded, the person never recovered; which, though not exactly borne out by the cases that have occurred since, shows the impression made on the mind of a man who was such an observer of nature. Before his death, Mr. Hunter saw a case of a wound of the dura mater recover. It is certain that there is less danger when the dura mater and pia mater are both injured: the danger being greater when the dura mater is injured without the pia mater. The reason is plain. In the former case, where both the dura mater and pia mater are wounded, a fungus immediately projects, and fills up the cavity. If, however, there is only a

small opening in the dura mater, and I were to put some quicksilver into it, where would it go?—into the lower part of the spine between the tunica arachnoides and dura matral covering; so would inflammation of the dura mater spread over the whole cavity of the canal, in the same way as erysipelas does over the surface of the body. Whereas, in the first kind of injury, fungus projecting through the opening, causes it to close readily by the process of adhesion that commonly takes place. I have seen many instances where the dura mater and pia mater have been wounded, but few where the dura mater only has been.

After trephining, the elevator should be introduced to raise the depressed bone, and so return it to its natural situation. There is no necessity to operate on a part where there is any risk, because the operation can be performed equally well on a part where there is no risk, the object being only to raise the bone.

CHAPTER II.

INJURIES OF THE SPINE.

*Dislocations of
the spine are very
rare.* It has generally been stated by surgeons that dislocations of the spinal column frequently occur ; but, if luxation of the spine ever does happen, it is extremely rare. For, in the numerous instances of violence done to the spine which I have seen, I have never witnessed a separation of one vertebra from another, through the intervertebral substance, without fracture of the articular processes ; or, if those processes remain unbroken, without a fracture through the bodies of the vertebrae. Still I would not be understood to deny the possibility of dislocation of the cervical vertebrae, as their articulatory processes are placed more obliquely than those of the other vertebrae. I must, however, observe that, from the vicinity of our hospitals* to the river, sailors are often brought into them with injuries of the spine, produced by falls from the yard-arm to the deck ; and, as there is almost always an opportunity of inspection in these cases, a dislocation must be very unusual, since I have never met with a single instance of it : those injuries having all proved to be fractures with dislocations.

I am well aware that respectable surgeons have described dislocation as occurring in the cervical verte-

* Guy's and St. Thomas's.

bræ; but my desire is to state the results of my own experience, without reference to that of others.

SECTION I.

STRUCTURE OF THE SPINAL COLUMN.

I will, first, give a short account of the structure of the spine, merely for the purpose of reviving ideas which may have faded from the memory.

Bones of the spine. The spinal column is composed of twenty-four vertebræ, which are divided into three classes; viz., the *cervical*, the *dorsal*, and the *lumbar*. They are very strongly connected by four articular processes, and are firmly joined by an elastic substance, which proceeds from the broad surface of the body of one vertebra to that of the other. The spinous processes of many of the vertebræ, and particularly those nearest to the centre of the column, are locked together, one being admitted into a depression of the other.

Inter-vertebral substance. The bodies of the vertebræ are united by a ligamento-cartilaginous substance, extremely elastic, and composed of concentric lamellæ, connected by oblique fibres, which decussate each other. The centre of this structure is mucous, and forms a pivot, which supports the central line of the vertebræ; whilst the elasticity and compressibility of the outer edge of this uniting medium allows the vertebræ to move upon this centre in all directions.

Anterior spinal ligaments. The column is also further connected by

an *anterior spinal ligament*, which proceeds from the second vertebra of the neck to the sacrum, and is united to all the bodies of the vertebræ excepting the first.

Posterior spinal ligament. There is also a *posterior spinal ligament*, situated within the canal of the spinal column, and proceeding from the second vertebra; but it is also intermixed with the perpendicular ligament; and descending to the sacrum, it sends out lateral processes to the superior and inferior edges of the bodies of the vertebræ.

Inter-vertebral and capsular ligaments. *Inter-vertebral ligaments* also pass in a crucial direction from vertebra to vertebra. The articular processes are united by *capsular ligaments*; and the transverse processes have ligaments passing from one to the other.

Ligamentum subflavum. Between the arches of the roots of the spinous processes is placed an elastic ligament, called the *ligamentum subflavum*, which allows of considerable separation between the spinous processes; and, by its elasticity, approximates them, rendering muscular support for the erect position of the body less necessary.

Ligaments of the cervical vertebræ. The vertebræ of the neck are united at their spinous processes by an elastic ligamentous substance, which is termed the *ligamentum nuchæ*. The head is connected to the spinal column by *capsular ligaments*, enclosing the condyles of the os occipitis and the articular processes of the atlas, or first vertebra. A *circular ligament* proceeds from the foramen magnum to the edge of the aperture

of the first vertebra. A *perpendicular ligament* passes from the anterior part of the foramen magnum to the dentiform process of the second vertebra. *Lateral ligaments* proceed from the edge of the foramen magnum and first vertebra on each side, and are united to the dentiform process of the second vertebra; these ligaments limit the lateral motions of the head. The first vertebra of the neck is united to the second by means of a *transverse ligament*, which is also fixed to the first vertebra on each side, and passes behind the dentiform process of the second vertebra.

The spinal column, therefore, by the number of its bones, the strength of its joints, and its connection with the bones of the chest, is most carefully protected from external injury; which is the more necessary because it serves two important purposes; first, that of supporting the head and all that part of the body situated above the pelvis; secondly, it contains and protects the spinal marrow, upon which the volition and sensation of the extremities depend *.

Classification of the Injuries. The effects which arise from violence done to the spine, are very similar to those which are produced by injuries to the head; being either concussion,—extravasation,—fracture,—fracture with depression,—or suppuration and ulceration.

* According to modern physiologists, volition and sensation reside in the brain, the spinal cord being merely a medium of communication; while the *proper* function of the spinal cord is purely *excito-motory*.—ED.

SECTION II.

CONCUSSION OF THE SPINAL MARROW.

Effects of. When a person receives a severe blow upon the spine, or has it suddenly bent from any great violence, a paralysis of the parts below will frequently succeed, proportioned in degree to the severity of the injury; and, after such an event, the person sometimes gradually recovers the motion and sensation of the paralysed parts.

Treatment. If the part be tender to the touch, or the patient complains of pain, blood should be taken away, near the injured part, by cupping or leeches; and the bowels should be kept freely open. After a week or ten days, if the patient be not much relieved, a blister should be applied, and the surface afterwards dressed with equal parts of the unguent. lyttæ and cerat. sabinæ. The extremities should be frequently rubbed with a liniment of a slightly stimulating nature; and, as sensation returns, electricity or galvanism may be beneficially employed.

Case. A man was admitted into Guy's Hospital (under the care of Dr. Curry) who had received a severe blow from a piece of wood falling upon his loins. When he was brought into the hospital, his lower extremities were in a great degree deprived of motion, and their sensation was much diminished. While resting on his back in bed, he could, with

much difficulty, draw up his legs, but could not bend them at a right angle with his body ; and a considerable time elapsed before the muscles of his lower extremities obeyed the efforts of his will. As there was still the appearance of severe contusion and much deep-seated tenderness at the injured part, blood was repeatedly taken away by cupping, and his bowels were kept freely open by calomel and saline medicines. When the pain and tenderness had been removed, a blister was applied, and a discharge kept up from the surface for three weeks. The liniment ammoniae was then applied to the extremities, and, in six weeks, the motion and sensation of the limbs had nearly returned. He was then submitted to the influence of electricity, and, in ten weeks, got perfectly well.

SECTION III.

EXTRAVASATION IN THE SPINAL CANAL.

Case. I have seen but very few examples of effusion of blood into the spinal canal ; one I recollect witnessing in St. Thomas's Hospital. A man received a severe blow upon the dorsal vertebrae, which produced complete paralysis of the lower extremities, and shortly after his admission into the hospital he died. Upon examination after death, slight extravasation was found in the spinal canal.

Case. I was consulted about a very interesting

case which was placed under the care of Mr. Heaviside; the particulars of which were as follow. A young gentleman was swinging, when some of his companions caught him by the neck with a rope, during the time that the swing was in rapid motion; by which the whole of the cervical portion of the spine was violently strained. As however the line slipped off immediately, he thought but little of it. For some months subsequent to the accident he was not aware of any pain or inconvenience; but his school-fellows observed that he was less active than usual, and, instead of filling up his time by play, he would be lying on the school forms, or leaning upon a stile or gate when in the fields. From this time he continued to decline, both in strength and power; and he was brought to London for advice, about the middle of the following May. His complaints were—occasional pains in his head, which were more severe and frequent at the back part of the head and neck, and extended down the back; stiffness of the muscles at the posterior part of the head and neck, which were indurated, and very tender to external pressure; he felt pain in moving his head or neck in any direction; and a great deficiency in the power of voluntary motion, especially in the limbs.

Treatment. Two setons were placed in the neck, and he took various medicines, without experiencing any benefit. His complaints, especially the paralytic affection of his limbs, got much worse; besides which,

he felt an extremely painful sensation of burning in the loins; this was succeeded, in a short time, by a sense of extreme coldness in the same part. The pulse and heat were natural.

A consultation was held by Dr. Bailey, Dr. Pemberton, Mr. Heaviside, and myself, and the application of mercury was determined on. The pilula hydrargyri was taken for a few days; but as it produced violent action upon the bowels, mercurial frictions were subsequently employed. He felt his limbs getting every day weaker, but his neck was more free from pain when moved, and he was more capable of moving it by his own natural efforts.

On the 7th of June his respiration became laborious; all his symptoms rapidly increased, and on the following day he expired; surviving the accident nearly twelve months.

Examination. The whole contents of his head were carefully examined, and appeared perfectly healthy. Upon sawing out the posterior parts of the cervical vertebrae, the theca vertebralis was found to be covered with blood, which had been effused between the theca and enclosing canal of bone. The dissection being further prosecuted, this effusion was found to extend from the first vertebra of the neck to the second vertebra of the loins, both inclusive.

The preparation, which is in the museum of Mr. Heaviside, only shews a small portion of the effused blood, that had become coagulated on the theca; the

remainder, being fluid, escaped during the examination.

SECTION IV.

FRACTURE OF THE SPINE WITHOUT DISPLACEMENT.

Peculiar character of the symptoms. These accidents, by admitting unnatural variations in the position of the spinal column, produce very extraordinary symptoms, and sometimes sudden death, even when the bones retain their situation.

Case. Mr. Else, who preceded Mr. Cline as teacher of anatomy at St. Thomas's Hospital, used to mention the following case in his lectures. A woman in the venereal ward, who was then under a mercurial course of treatment, while sitting in bed eating her dinner, was observed to fall suddenly forward; and the patients hastening to her found she was dead. Upon examination of her body after death, the dentiform process of the second vertebra was found broken off. The head, in falling forward, had forced the root of the process back upon the spinal marrow, which occasioned her instant dissolution.

Case. At the time I lived with Mr. Cline as his apprentice, the following case occurred in his practice. A boy, about three years of age, fell and severely injured his neck. When Mr. Cline was consulted, the patient was obliged to walk carefully upright, as persons do when carrying a great weight on the head, and when he wished to examine any

object beneath him, he supported his chin upon his hands and gradually lowered his head, to enable him to direct his eyes downwards; but if the object was above him, he placed his hands at the back of his head, and very gradually raised it until his eyes caught the point which he wished to see. If, in playing with other children, they ran against him, it produced a shock which caused great pain, and he was obliged to support his chin with his hand, and to go immediately to a table, upon which he placed his elbows, thus supporting his head until the effects of concussion had subsided.

He died about twelve months after the accident, and, upon examining the spine, Mr. Cline found the first cervical vertebra had been fractured transversely, so that the dentiform process of the second vertebra, having lost its support, compressed the spinal marrow under different inclinations of the head; and, as the patient could not depend upon the support of the muscles of the neck, he therefore used his hands to support his head during different motions and positions.

Fracture of the spinous processes. Portions of the spinous processes are sometimes broken off, but these accidents do not usually affect the spinal marrow, unless when attended with considerable concussion. Mr. Aston Key, in dissecting a subject at St. Thomas's Hospital, found a spinous process loose, which he kindly brought to me*, with the following account of the case. "The

* Sir A. Cooper.

fractured vertebra was the third dorsal. The cause could not be ascertained, as it occurred in a subject which was brought into the dissecting room. There was a complete articulation formed between the fractured surfaces, which had become covered with a thin layer of cartilage. The synovial membrane and capsular ligaments resembled those of other joints, excepting that the former was more vascular. The fluid within the joint had the lubricating feel characterizing synovia."

Case. A boy was admitted into Guy's Hospital, who had been endeavouring to support a heavy wheel by putting his head between the spokes, and receiving its weight upon his shoulders. The wheel overbalanced him, and he fell bent double. When he was brought to the hospital, although perfectly straight before, he had the appearance of one who had long suffered from distorted spine; yet this accident had not produced paralysis of the lower extremities. Three or four spinous processes had been broken off, and the muscles torn on one side, so as to give an obliquity to the situations of the fractured portions. The boy quickly recovered, without any particular attention, and was discharged with the free use of his limbs; but he still remained deformed.

SECTION V.

FRACTURE WITH DISPLACEMENT.

The separation of one vertebra from another without fracture is of very rare occurrence; and the supposed dislocations of the spine are, in a very large majority of cases, fractures with displacement. When this happens, the parts of the body situated below the seat of injury become paralysed.

As the symptoms and result of the accident differ according to the situation of the fractured bones, these injuries may be divided into two classes; first, those which occur above the third cervical vertebra; and secondly, those which occur below that bone.

In the first class, the accident is almost always immediately fatal, if the displacement be to the usual extent. Death, in the second class, occurs at various periods after the injury. The origin of the phrenic nerve, from the third and fourth cervical pairs, is the reason of this difference; for as the parts below are paralyzed by the pressure upon the spinal cord, if the accident be below the fourth cervical vertebra, the phrenic nerve retains its functions, and the diaphragm supports respiration; but if, on the contrary, the fracture be situated above the origin of this nerve, death immediately ensues. A small filament of the second cervical nerve does, indeed, contribute to

the formation of the phrenic, but it is insufficient to support respiration under fracture of the third vertebra.

The effects which arise from fracture and displacement of the spine, below the origin of the phrenic nerve, depend upon the proximity of the accident to the head.

Symptoms of lumbar displacement. Thus, if it occur in the lumbar verte-
bræ, the person immediately loses all power of motion and sensation in his lower extremities. Pinching, burning with caustic, or the application of a blister, are alike unfelt. The action of the sphincter ani being destroyed, his fæces pass off involuntarily; and the bladder being unable to contract, through paralysis of its muscular coat, his urine is retained.

The involuntary powers of the limbs remain unimpaired. The circulation in them is more languid, perhaps, but is still sufficiently active to preserve their heat; and local inflammation can be excited in them by blisters, or other means, proving thereby that the involuntary (*organic*) functions may proceed in parts which are cut off from their connection with the brain and spinal marrow*.

* This strongly confirms and elucidates Dr. M. Hall's explanation of the functions of the medulla spinalis. He conceives that it is partly a source of power in itself, and partly a medium of communication with the brain; that sensation and volition rest solely in the brain; that muscular motion, and all the operations of organic life which are independent of sensation and

Symptoms of dorsal displacement. When the dorsal vertebræ are the seat of injury, all those parts situated below the fracture are paralysed, as in the former case; but in addition, the abdomen becomes distended with air, which escapes into the intestines in consequence of the diminished powers of the part; this gradually subsides after the patient's bowels have been freely opened.

Displacement of the cervical vertebrae. If the fracture with displacement takes place in any of the cervical vertebræ below the fourth, the same symptoms occur in the body and lower extremities as when the dorsal vertebræ are injured; and there is also a partial paralysis of the upper extremities, but seldom such as to deprive the patient of all motion and sensation. Respiration in these cases is difficult, and is performed wholly by the diaphragm, the power of the intercostals being destroyed by the accident. The abdomen also is tumid from flatulency. When it happens above the fourth cervical vertebra, the person generally dies on the instant; because the fracture with displacement being above the origin of the phrenic nerve, the diaphragm, which is the only agent in supporting respiration, loses its power, and dissolution almost immediately results.

volition, depend solely on the spinal cord. The posterior roots of the spinal nerves, and nerves of the medulla oblongata, as he conceives, contain sensitive and excito-motory fibres; the anterior roots, spontano-motory (volition) and reflecto-motory fibres.—ED.

Period of termination.

Patients rarely recover from these injuries to any part of the spine, but the period at which life is destroyed varies according to the seat and violence of the accident.

In the loins, if the displacement be considerable, the person may die in three weeks; but if slight, the patient may survive many weeks. I recollect a case in which the patient lived two years after a supposed fracture with displacement of the lumbar vertebræ; but the precise nature of the injury was uncertain, as the friends would not permit any examination of the body after death, by which alone the extent of the mischief could have been decidedly ascertained. The patient usually survives a much shorter period when the dorsal vertebræ are injured; although I have known a gentleman live nine months after such an accident to this part, which was occasioned by his horse falling, and rolling upon him, after leaping over a wide and deep road, to which he came unawares whilst riding at speed. After the occurrence of such injury between the fourth and seventh cervical vertebræ, the patient seldom lives longer than four or five days, and in some cases dies within eight-and-forty hours after the accident.

Ossific union. It is well known, that ossific union has taken place after fracture with slight displacement of the vertebræ. Mr. Brooks has a preparation shewing a union of this kind; and in the museum at the College of Surgeons there is another portion of

fractured spine, presented by Mr. Harrold, of Cheshunt, in which union has been produced after an accident of this nature. There can be no fear, then, as to the restoration of the part, if the pressure on the spinal marrow could be removed.

Treatment. In the treatment of fractures of the spine, with displacement, no plan, hitherto adopted, has been productive of any permanent benefit. To bring the spine into its natural form by extension, would be impossible, if it were attempted ; and even if that object were attained, it would scarcely be practicable to preserve it in its situation, as the least motion would again displace it. Rest will be essential to ossific union ; but ossific union will not save the patient, if the pressure upon the spinal marrow be not removed.

Mr. Cline's operation. Mr. Henry Cline, an excellent anatomi-
st and a good surgeon, was the first person who took a scientific view of this accident, and attempted to afford relief, in such cases, by operation ; as he considered that cases of this kind should be treated in a similar manner to those of fracture with depression of the skull. With this object in view, he had made numerous experiments, the result of which gave him reason to suppose that such an operation might be successful. He cut down upon the spine, at the part where the displacement was evident, and, having exposed the spinous process and arch of the injured vertebra, he sawed through the

arch near to the transverse process with a small trephine of his own invention ; and then, by raising the depressed portion of bone, he removed the pressure from the spinal marrow.

Case where trephining might be employed. In many cases of fracture with displacement of the spine, the spinal marrow is either partially or completely torn through. In such instances, little good could result from an operation. In others, the spinal marrow is apparently but little injured ; and in such cases it was, that Mr. Cline thought there might be hope from an operation. Mr. Tyrrell * has performed the operation since Mr. Cline, but both cases terminated fatally. Whether future trials will be more successful, it is difficult to say ; we cannot speak decidedly on the subject, as the first operations have been unsuccessful. The proposal is laudable, and the operation is not severe, nor does it increase the danger of the patient ; time and experiment only can determine its value. If we could save one life in a hundred by it we should deserve well of mankind ; and if any good does ultimately result from it, Mr. Henry Cline has the merit of proposing it.—
Palmam qui meruit ferat.

* For a detailed account of Mr. Tyrrell's case, the reader is referred to Mr. Tyrrell's Edition of Sir A. Cooper's Lectures on Surgery ; Vol. II., p. 11, et seq.

SECTION VI.

SUPPURATION AND ULCERATION OF THE SPINAL MARROW.

The only case, in which I have had an opportunity of ascertaining this disease by dissection, was the following.

Case. A gentleman, who resided about eight miles from London, had, by a fall, received a severe blow on his spine, which did not, however, produce any immediate ill effect. Some time after, having been much exposed to changes of weather, he was suddenly seized with pain in his back, which was followed by paraplegia, retention of urine, and involuntary discharge of faeces. I was requested to see him on account of the retention of urine, and attended him for a length of time, for the purpose of using the catheter. For several weeks his symptoms remained unchanged, excepting the appearance of a troublesome sore on the nates. Towards the close of his existence, he complained of much uneasiness and distension at the upper part of his abdomen. His appetite failed, he rejected his food, and he had a great deal of fever, with quick pulse and profuse perspiration. He sank gradually, worn out by irritation.

Appearance on dissection. Upon opening the spinal sheath, a milky fluid was found within it, just above the cauda

equina ; and higher up, about three inches, the spinal marrow was ulcerated to a considerable depth, and was in that softened state which the brain assumes when it is rendered semifluid by putrefaction. All the other parts of the body were healthy, excepting the bladder, which was considerably inflamed.

Treatment. In a case like this, precautions should be taken to prevent inflammation, by cupping or leeches : subsequently, counter irritation, by blisters or tartar emetic, will be useful : issues or setons may also, in some cases, prove beneficial.

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